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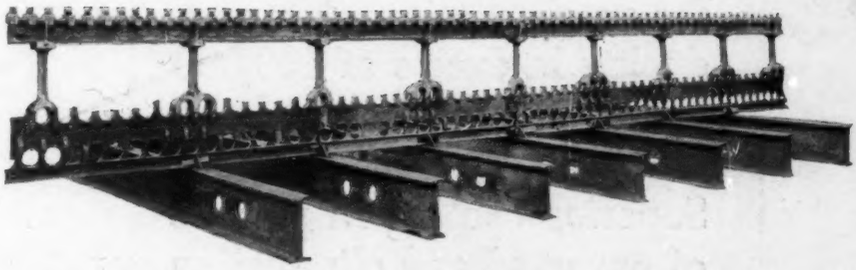

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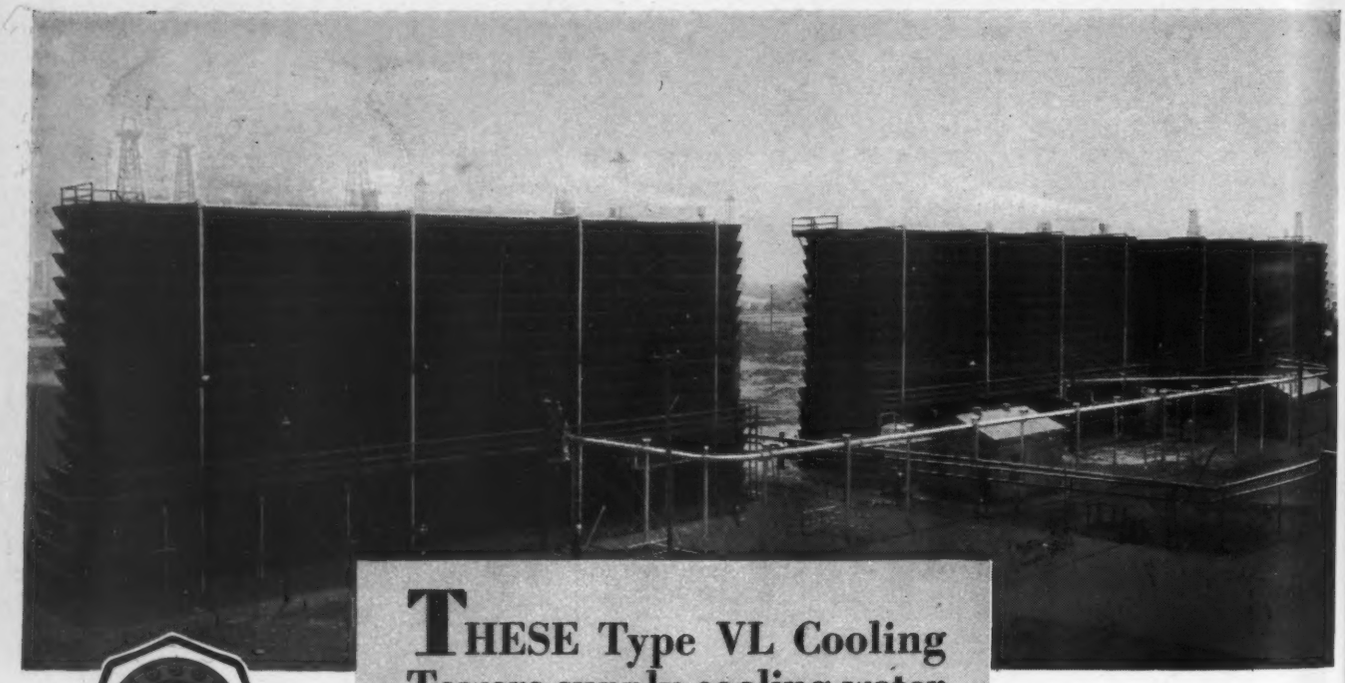

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AUGUST, 1929

GRADY TRIPLETT, *Editor*

GEORGE REID, *Associate Editor*

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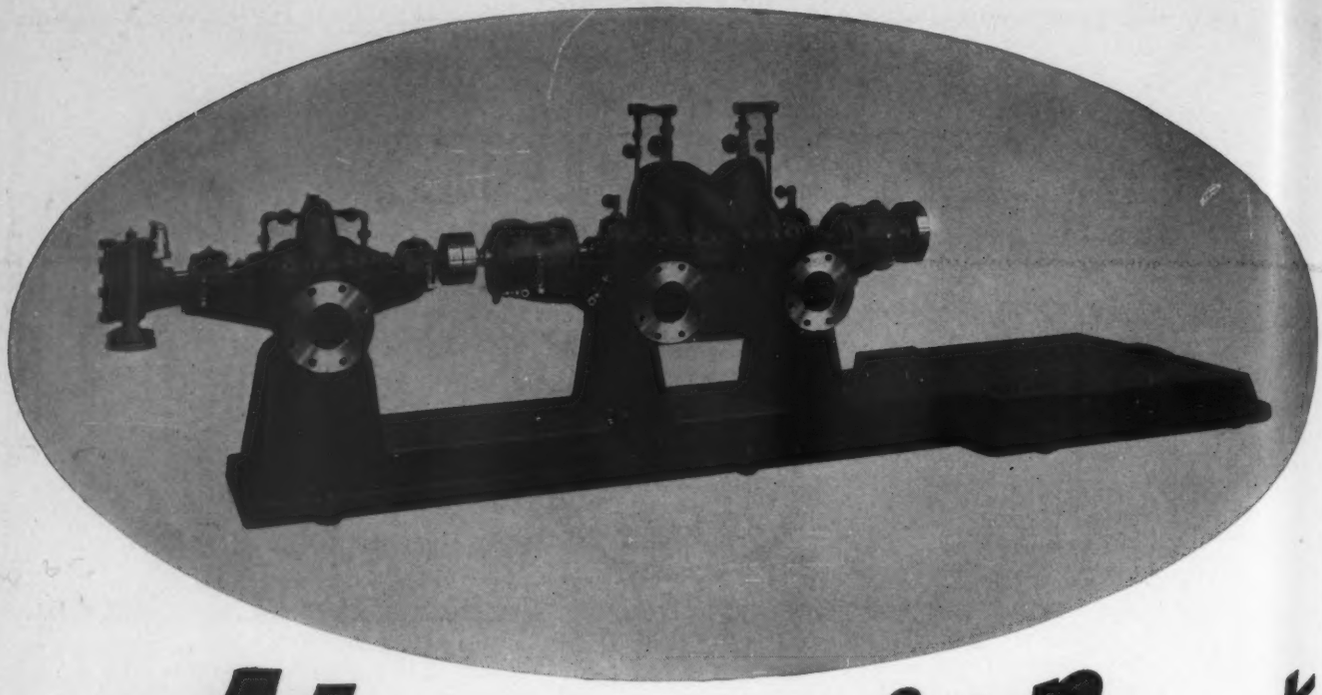

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Let's Have Some Empty Tanks

NOW that gasoline prices have yielded to an excess supply, the best move refiners can make is to get rid of the surplus and build a stable structure again.

The threat against the gasoline market came in September and October of 1928. The curve that designates runs had a sharp peak in it then. The period of peak runs was brief but it put gasoline in storage for the winter. When runs of this spring were carried to a figure higher than consumption justified the day of a crippled market was invited.

It can be set down as a perpetual guide that no product will ever continue to sell at a profitable figure when its makers are crowded for space to store it. That applies to circus lemonade as well as to gasoline. And the gasoline market of the first half of 1929 had to yield to a mounting supply.

When tanks were all full, lower prices were the answer. Lower prices will be the answer to any such condition. That is the reason the best move the refiners of the United States can now make is to empty their tanks.

With empty tanks a stable and satisfactory market can be established automatically and it will maintain itself from its own economic condition. But statements, published prices and exhortation will never maintain a fair market in opposition to full tanks.

There was miscalculation in regard to the gasoline market of 1929. Consumption thus far has been in excess of expectation. But even this gift of higher consumption was too much for the amount of gasoline the refiners poured into their tanks. Certainly refiners have spent some time in calculating their sales against runs. But with sales higher than calculation, still their market crashed.

An excellent market, which carried into the fall months, was responsible for too much gasoline being made in September and October of last year. The drop in prices in June of this year should be sufficient to prevent similar refinery operation this fall. This winter should be a period of empty tanks for refiners.

But what the refining industry evidently needs is some empty tanks for each season. Empty tanks are an evidence of controlled refinery runs. No man with a few empty tanks is compelled to move gasoline over night. Empty tanks will not bring those floods of letters and telegrams, which jobbers so often receive. Without these things, there will be no cause for reducing prices.

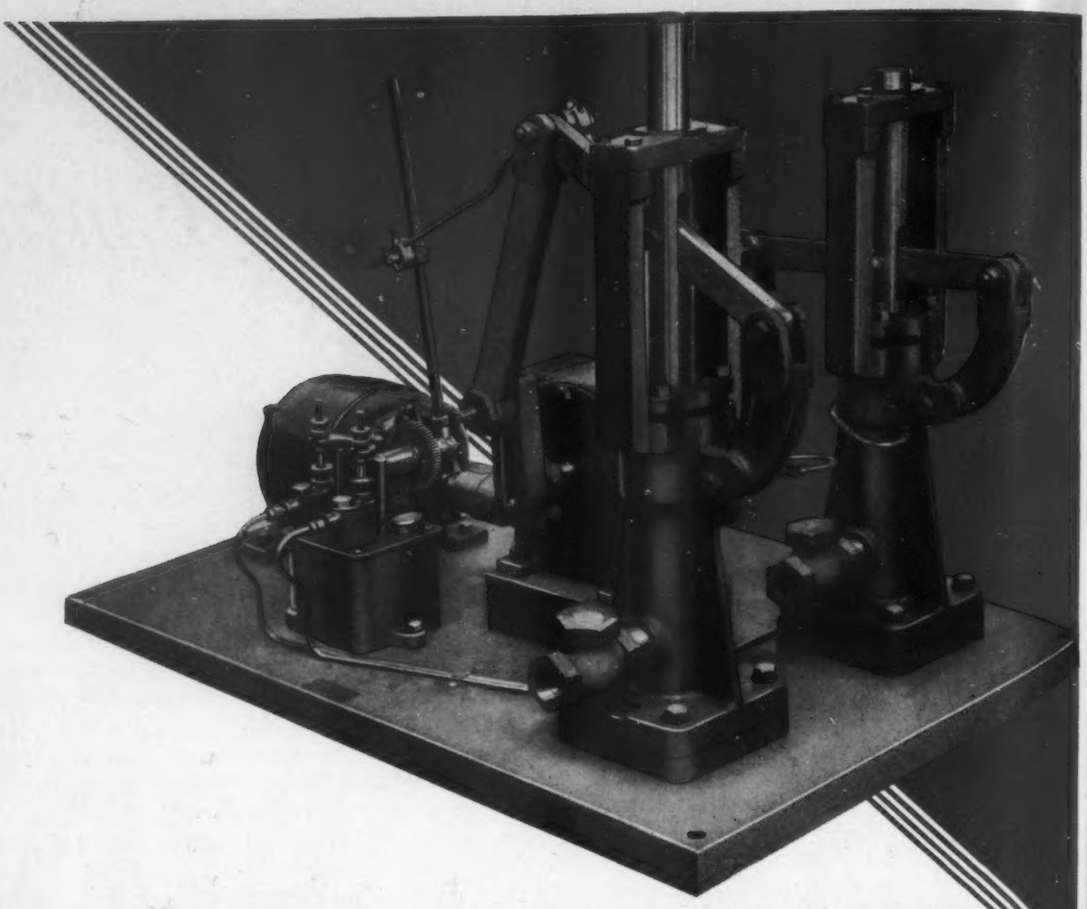
There is no necessity for seeking to fix the blame for the present depressed gasoline market. It came as a result of refiners having more gasoline than could be consumed. Either there were no more tanks for storing it or no money for paying the cost of storage. A few empty tanks in June would have held prices at a profit level.

The refining plants of the United States can not run at capacity for many weeks without crushing prices. The example is so old it deserves little mention. But it happened in 1929 after happening many times before that.

The coming winter will afford ample time for bringing stocks down to a proper level. This proper level will certainly lease some empty tanks. Then if each plant manager will get friendly with empty tanks and not fear to have them next summer there will be profit in gasoline.

Grady Gilbert

BOOTH 98
Texas Building



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Crude Tariff Failure a Boon to Foreign Trade Expansion

Refiners Insured of Expanded European Outlets Which Await Further Cultivation

By H. J. STRUTH
Staff Economist

FAILURE of congress to impose a duty upon foreign crude oil imported into the United States can be considered a benefit to the refining industry. Despite arguments in favor of a tariff on foreign crude, facts at hand disprove its advocacy. The fact that for many years exports of petroleum products have considerably exceeded imports of crude, makes it apparent that the margin between imports and exports has been and is a decidedly favorable factor to the American petroleum industry. It is particularly true that the refining branch of the industry has derived no little benefit from the growing foreign demand for gasoline and other petroleum products, whereas indications point to positive further growth in this direction, awaiting only further cultivation by American refiners and marketers. It is therefor evident that if the proposed tariff measure would have been approved, the industry would have faced the inevitable plight of losing a large share of its growing foreign business, in which American refiners actively participate.

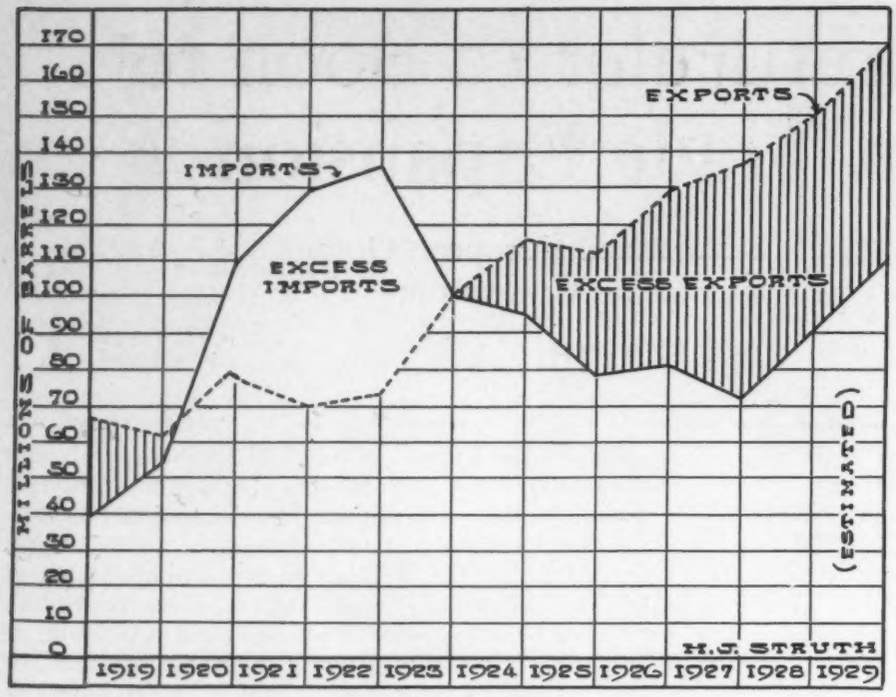
During the past 11 years, 1918 to 1928, inclusive, exports of petroleum and its products have exceeded imports by a total of 110,767,000 barrels. During that period, imports have aggregated 983,228,000 barrels, while exports have amounted to 1,093,995,000 barrels. During 1928, over half of the entire excess of exports over imports over the 11-year period cited represented the balance in favor of the American petroleum industry. During that year, the excess of exports over imports amounted to 59,049,000 barrels, being the difference between imports of 91,382,000 barrels and exports of 150,431,000 barrels. During the first five months of this year, imports have aggregated 45,908,000 barrels, while exports amounted to 62,184,000 barrels, a balance in favor of the United States of 16,276,000 barrels. These figures alone prove the fallacy of placing a tariff on imported petroleum, at the risk of losing a growing favorable balance. In fact, last year's figures show that for every barrel of oil imported into the United States, 1.65 barrels was exported to foreign markets. Surely there is nothing wrong with trading on that basis.

GROWTH OF FOREIGN TRADE

The records show that only during a period of three years, following the World War, did imports of petroleum and its products exceed exports. The accompanying chart shows this and exhibits the remarkable growth that has taken place in foreign trade during recent years. While it may be true that imported crude has made the supply appear larger than necessary, it is also a fact that exports of refined oils have more than offset the effect of growing imports of foreign crudes. Thus, while the placing of a tariff on foreign crude might have reduced the American supply to some extent, natural consequences following such action would have undoubtedly wrought havoc with the foreign trade in refined oils. In the final analysis, the petroleum industry, particularly the refining branch, would have faced the prospect of a shrinking foreign demand for its

CRUDE RUNS TO STILLS, GASOLINE AND GAS AND FUEL OIL STOCKS MONTH ENDING JULY 27
(Barrels of 42 Gallons)
(From American Petroleum Institute Weekly Refinery Statistics for the United States)

United States Daily Average	Percent Potential Capacity Reporting	Crude Runs To Stills	Percent Operated of Total Capacity Reporting	Gasoline Stocks	Gas Oil and Fuel Oil Stocks
Total week July 27.....	91.4	18,285,500	85.6	35,942,000	132,492,000
Daily average		2,612,200			
Total week July 20.....	90.9	18,089,100	85.1	36,002,000	141,925,000
Daily average		2,584,200			
Total week July 13.....	91.0	18,011,000	84.7	37,714,000	140,279,000
Daily average		2,573,000			
Total week July 6.....	89.9	18,127,600	86.3	39,140,000	139,950,000
Daily average		2,637,000			
Daily average 4 weeks.....		2,601,600			



TREND OF IMPORTS AND EXPORTS OF PETROLEUM AND ITS PRODUCTS — 1918 - 1929

Ribbed Area shows balance in favor of United States, being in excess of imports. White area shows period when imports exceeded exports

products that would have automatically placed the supply situation in as bad or worse plight than advocates of the tariff inferred it to be under present conditions. No doubt, the imposition of such a tariff would also have resulted in the removal of American refineries to their foreign sources of crude supply, eliminating important home industry as well as revenue.

IMPORTS REALLY NEEDED

Since numerous large refineries located along the East Coast, as well as on the Gulf Coast, are consuming large quantities of South American oil, from production owned there, it follows that these units are vitally concerned with the future development of foreign oil resources. Naturally, any attempt to curtail the use of foreign crude produced by these American companies would be met with the alternative of removing manufacturing facilities to foreign shores. It is also a fact that refined oils exported to all parts of the world by American refiners are not all manufactured from foreign crudes. In fact, probably only a small percentage of the exported petroleum products are actually produced from foreign oil; large quantities, particularly lubricants and wax, being produced from American crudes exclusively. A refiner cannot be censured for refining foreign crude where the advantage in cost and transportation is in his favor, particularly if part of his capital is invested in foreign production. Perhaps, also, the time will arrive when foreign crude produced by American companies will furnish a definite need in the United States. The mere fact that the American producer is creating a surplus supply through overproduction at this time is not positive assurance against a future supply. As a matter of fact, the industry has really had need for the importation of foreign oil, for even now, the alleged excessive production is inadequate to supply current requirements. Supply and demand figures prove that domestic and foreign requirements are and have been in excess of domestic production of crude. Thus it might even be said that there is really a shortage of domestic crude in the United States at the present time. Only the fact that imports are somewhat larger than the deficit shown by domestic production has created an excessive supply of oil.

FOREIGN DEMAND GROWING

Apparently, exports of petroleum and its products will maintain the pace established last year, with the prospect of reaching a total for 1929 of approximately 170 million barrels. Since imports of both crude and refined oil are expected to exceed 100 million barrels this year, possibly 110 million barrels, excess of exports over imports will show a margin of at least 60 million barrels. At any rate, it is becoming more and more apparent that the market for American petroleum products abroad is growing by leaps and bounds and it is up to the refining branch of the industry to corral the new outlets which are awaiting cultivation. While the growth in motor transportation throughout the rest of the world has been sluggish in the past, there is now every indication that the pace is being accelerated. Europe has recovered from the war and its leading countries are rapidly becoming motorized. American motor cars are being exported in increasing volume to all parts of Europe as well as the rest of the world, assuring a constantly expanding market for gasoline and lubricants. The American petroleum refiner, alive to the opportunities for expanding markets abroad, should aggressively pursue these potential outlets. At the same time, the American producer should not neglect the opportunities for further investment and development in foreign sources of future crude supplies.

World-wide events justify aggressive cultivation of foreign markets by the American petroleum industry, and invite further expansion of foreign producing activities with American capital. Under these conditions it would appear an act of folly to stifle the influx of foreign crude. After all, much of the crude imported from South America is really American production, and it is fortunate that far-seeing American oil companies have been able to secure and develop these prolific sources of supply, insuring ample crude against future contingencies. At any rate, as long as exports of refined oils continue to show a wide margin over crude imports, the industry can be considered to be pursuing sound business principles.

The Manufacture of Commercial Anhydrous[1] Aluminum Chloride

By A. M. McAFEE
Gulf Refining Company, Port Arthur, Texas

IN 1915, at the San Francisco meeting of the American Institute of Chemical Engineers, the author presented a paper on the "Improvement of High-Boiling Petroleum Oils and the Manufacture of Gasoline as a By-Product Therefrom by the Action of Aluminum Chloride" (2.)* In that paper it was indicated that further papers might be forthcoming. That was fourteen years ago. That was also the beginning of litigation which has run the gamut from interference proceedings in the Patent Office and federal courts to suits for title in state and federal courts, finally culminating in the Supreme Court, which a few months ago rang down the curtain on the proceedings. While this litigation was in progress the writer did not feel that it was proper to discuss publicly the subject of aluminum chloride.

These years not only have been full of litigation but have also been full of developments covering the large-scale manufacture and uses of aluminum chloride by Gulf Refining Company. It is the purpose of this paper to discuss the manufacture of commercial anhydrous aluminum chloride and to give some details of Gulf Refining Company's method of manufacturing this interesting chemical in quantities and at a cost which rank it among the heavy chemicals of commerce, such as caustic soda.

ALUMINUM CHLORIDE MADE COMMERCIALLY AVAILABLE

In the year 1913 the writer purchased a few pounds of aluminum chloride for $1.50 per pound. It required six weeks to get it. Today Gulf Refining Company is manufacturing aluminum chloride at Port Arthur, Texas, from bauxite ore and chlorine at the rate of 75,000 pounds per day and at a cost such that it can be purchased in carload lots at 5 cents per pound.

It is amusing to read the remarks about the high cost of aluminum chloride which nearly always accompany the published references to its uses. They say it will do this and do that, but the usual "but" is that it is too expensive. The lowest figure that the writer has seen published is 15 cents per pound and that seemed to be a wish rather than a reality. Within the past few months an article (1) has been published in which the statement is made that all the anthraquinone manufactured in this country is being made synthetically by means of aluminum chloride, but the process is handicapped by the high cost of aluminum chloride and the difficulty of handling it. It is hoped that the present paper will effectually dispose of the first objection as to cost, and in regard to handling it should be pointed out that Gulf Refining Company has made and consumed thousands of tons at its Port Arthur refinery and has shipped hundreds of tons in iron drums by rail to its Fort Worth refinery without difficulty.

Baeyer's statement long ago that the story of the uses of aluminum chloride sounds like a fairy tale, is true. Elbs' "Synthetischen Darstellungs Methoden," Volume 2, published in 1891, devotes 45 pages to alumnium chloride in the Friedel and Crafts syntheses of hydrocarbons, ketones, acid amides, phenols,

[1]Presented before the meeting of the American Institute of Chemical Engineers, Philadelphia, Pa., Jun 19 to 21, 1929.
*Nnmbers in parenthesis refer to literature cited at end of article.

Development of Aluminum Chloride

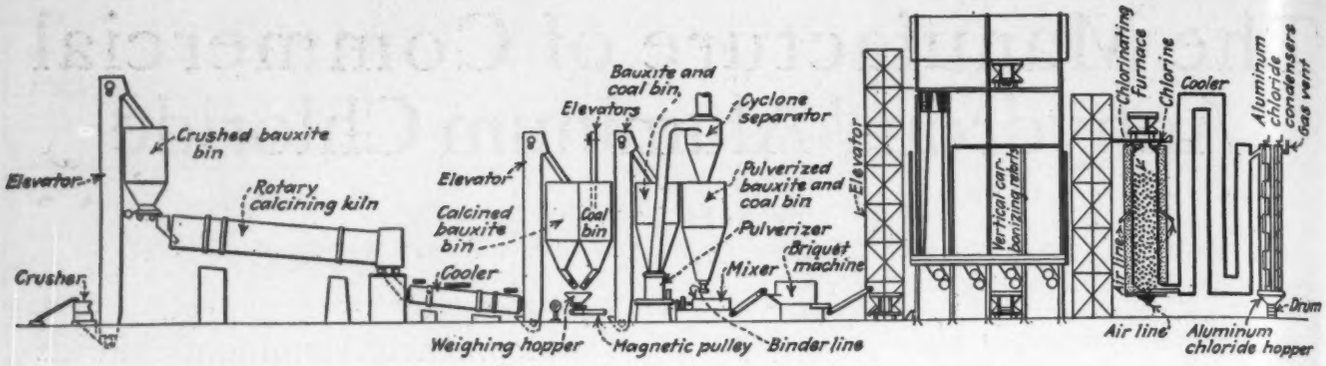
CHEMICAL engineering in the petroleum industry has contributed not alone to the progress of an important catalytic process but has paved the way for accelerated progress in the chemical process industries through the development of methods of preparing cheap aluminum chloride.

Baeyer's statement long ago that the story of the uses of this chemical sounds like a fairy tale, is true, says Dr. McAfee in the accompanying article. The miracles performed by Friedel and Crafts 50 years ago, which have since lain dormant because of high cost of the chemical, may again be brought to light, revived and commercially applied. Aluminum chloride at perhaps less than five cents per pound, as against $1.50 per pound 15 years ago, opens the way for many interesting possibilities commercially.

The accompanying article by Dr. McAfee, Superintendent Aluminum Chloride Division, Gulf Refining Company, Port Arthur, Texas, is a classic revelation of patient, exhaustive and persistant chemical engineering development. The results of such research are shown by the fact that his company produced 75,000 pounds of the chemical daily at a cost permitting its sale at five cents per pound. Gulf Refining Company, January 1, was operating 89 units of its McAfee catalytic cracking process with a total capacity of 55,600 barrels daily.

For the first time, in this article, are the details of the aluminum chloride process made public. Not only is the petroleum refining industry interested in its development but many process industries are affected, the most important of which is the dye industry, where the potentialities of cheap aluminum chloride can hardly be appraised.

Court records show that Gulf Refining Company has spent $4,600,000 on its aluminum chloride division. Each day, at Port Arthur, two carloads of Arkansas Bauxite and two car loads of Louisiana salt are consumed by its aluminum chloride works.



Diagrammatic Flow Sheet of the Gulf Process for Manufacture of Commercial Anhydrous Aluminum Chloride

etc. Meyer and Jacobsen, 1902 edition, contains one hundred and seventy-eight references to various applications of aluminum chloride in synthetic organic chemistry. Its possibilities in commercial organic syntheses have long been recognized, but little progress commercially has been made heretofore, on account of the high cost and inadequate supply. Not until recent years has there been a determined and successful effort to make aluminum chloride cheaply and in large quantities. To Gulf Refining Company goes the credit of having first tackled and solved this problem. Here, again, necessity was the mother of invention. Gulf Refining Company was in possession of a process for making gasoline from higher boiling hydrocarbons and of a process for refining petroleum oils in general, and lubricating oils in particular, by means of this remarkable chemical. The possibilities of these inventions were alluring, but they were indeed fairy stories until aluminum chloride could be made from basic raw materials (not metallic aluminum) at a reasonable cost and in thousands of tons. Gulf Refining Company is so making and using it now for these purposes and doubtless will continue to do so.

DEVELOPMENT OF PROCESS

Its first attempt to make aluminum chloride in a large way was started in 1915. There was, of course, no precedent to which to turn for help. The only alternative was to make the best guess possible and let Gulf Refining Company foot the bills, which it generously did for several long, lean years. The first apparatus consisted of vertical fire-clay retorts about 24 inches inside diameter by 20 feet in height. These were heated from the outside. The fire-clay tile cracked from top to bottom. No aluminum chloride was made except when metallic aluminum was used which, of course, was out of the question. Cost—six months' time and thousands of dollars. Then circle fire brick were substituted for the fire-clay tile. This was an improvement inasmuch as the fire brick did not crack under the heat of 1600°F. but, as is well known, chlorine is a lively agent at ordinary earthly temperatures; heat it to 1600°F. and it eats brick. This was too expensive to be considered. Cost—another six months and another several thousand dollars. For trial No. 3 the best ceramic experts which the country afforded were consulted. Retorts of porcelain were built with ground joints fired with outside producer gas to keep down hot spots. But chlorine at 1600°F. in the presence of carbon devours porcelain quite as readily as fire brick. An attempt was made to produce aluminum chloride by applying the necessary heat through retort walls to bauxite and carbon and chlorine. Where the heat should be greatest it was least; and where it was most intense, heat was not desired—that is, along the retort walls. At these temperatures it takes chlorine a surprisingly short time to eat a hole in a retort wall and that hole does not get smaller.

The records show that approximately two years and one million dollars were spent trying to make aluminum chlorine from bauxite ore in a large way without bringing the cost of production to reasonable figures. It was realized that there were substantial reasons why this chemical had never been made in large amounts and why its cost was so often mentioned as making it prohibitive in the arts.

But this time and money were not spent in vain. Many important details as to how to do it and how not to do it were learned. There were several more years of development work, but these years of effort did not give negative results. Each successive step proved to be in the right direction, until today the process is one of extreme simplicity.

DETAILS OF PRESENT PROCESS

The present process, which has been operating successfully for several years, is as follows:

The crude bauxite ore, which should be reasonably low in silica and iron, is calcined in an internally heated rotary kiln at about 1800°F. to drive off the free and combined moisture which usually amounts to about 40 per cent. of the ore. From the kiln, the bauxite is delivered by belt conveyor and bucket elevator to a weighing hopper where a good coking coal is added in the proportion by weight of approximately three parts of bauxite to one of coal. The mixture of bauxite and coal is then put through a pulverizer where the two solids are ground to a powder. From here it is directed to overhead hoppers, which feed into mixing vats to which is delivered a liquid binder, such as wax tailings or melted asphalt. The mixers discharge automatically into briquetting machines, which press the bauxite, coal, and binder into briquets under a pressure of 3000 pounds per square inch. Each briquet weighs approximately two pounds. Before chlorinating, all hydrocarbons, as well as moisture, must be driven out of the charge;

otherwise there will be a waste of chlorine as hydrogen chloride. Hence the briquets are preheated to approximately 1500°F., thus driving out the volatile matter in the coal and leaving a hard briquet composed of approximately 82 per cent. bauxite and 18 per cent. carbon. The hot carbonized briquets are then charged to the chlorinating furnaces.

The largest chlorinating furnace which Gulf Refining Company has thus far built has a capacity of 40,000 pounds of aluminum chloride per day. It has an inside diameter of five feet and the shaft is 20 feet in height. The shaft consists of two courses of circular fire brick and behind these is a layer of powdered bauxite incased by an iron jacket. The object of the powdered bauxite is to protect the iron against chlorine. Near the top of the shaft are inlets for chlorine, and near the bottom is an outlet for aluminum chloride connected to condensers. This sized furnace takes about 20 tons of carbonized briquets at a charge. They are introduced through an opening at the top of the shaft. A blast of air is then introduced at a point near the bottom and halfway up the shaft for about 15 minutes, at the end of which time the charge of briquets will have been heated to the desired chlorinating temperature of about 1600°F. The top door is then closed and chlorine turned in for a period of from eight to 10 hours, when it becomes necessary to replenish the charge of briquets and restore heat. With smaller sized chlorinating furnaces it is necessary to recharge and restore heat more frequently. Thus the operation proceeds in any particular furnace until the fire-brick lining must be renewed. Under present operating practice a lining is good for about 100 days.

IMPURITIES IN COMMERCIAL PRODUCT

Having in mind that all of the constituents of bauxite are converted into volatile chlorides, the quality of the aluminum chloride produced obviously depends upon the quality of the bauxite used. The analysis of bauxite is generally given on the dried basis, and that is what has been used in the following discussion. A bauxite containing not less than 57.5 per cent. alumina is considered to be good quality in respect to its alumina content. Aside from fractional amounts of alkali and alkaline earth elements, and perhaps rare earth elements, the remaining constituents of bauxite are combined moisture and the oxides of silicon, titanium, and iron. In the Arkansas and South American bauxites, the combined moisture and titania content vary only slightly, usually 29 to 31 per cent. and two to three per cent., respectively. Silica and ferric oxide are the variables to be watched. The presence of silica means the loss of chlorine as silicon tetrachloride, and the more iron there is in the ore the more ferric chloride in the aluminum chloride. It is preferable to use a bauxite containing less than five per cent. silica and three per cent. iron oxide. With these constituents fixed at a maximum figure, the alumina content takes care of itself. There is an abundance of bauxite available in South America and considerable in Arkansas running much lower than five and three per cent. of silica and iron oxide, respectively. The ore now in use, and which has been used for some time, produces commercial aluminum chloride containing not less than 94 per cent. aluminum chloride, the remainder being varying percentages of the chlorides of iron, titanium, and silicon, in amounts diminishing in the order named.

DEVELOPMENT OF CONDENSERS FOR ALUMIINUM CHLORIDE

A few words might be said about aluminum chloride condensers. This equipment also went through a development stage with plenty of grief. If you have ever had occasion to prepare aluminum chloride in the laboratory, you probably followed Gattermann's directions, which describe at some length how to avoid stoppage of the apparatus by aluminum chloride condensing where it is not wanted. Doubtless you were impressed with the importance of observing his precautions. As you know, aluminum chloride passes from the vapor to the solid phase, under substantially atmospheric pressure, without going through the liquid phase. It condenses quickly and is a very effective stopper.

Another problem was what material should be used for large-scale condensing; and another, what design. In the early days a modest-sized brick condenser with staggered baffles was used. This was connected as closely as possible to the chlorinating furnace. The aluminum chloride had to be discharged by hand. This did fairly well for that scale of operation, but when it came to larger production the manual labor required to remove the chemical was found to be prohibitive. Another item which did not show up in the smaller condensers was even more serious. Carbon monoxide is one of the gaseous products of the reaction. The brick condensers used at that time were about 30 feet long, 12 feet high, and six feet wide. This provided space for the accumulation of sufficient carbon monoxide which, when mixed with air as would often occur, resulted in an explosion which at times would wreck the whole condenser. Many of the present employees of the Gulf Refining Company have been with the process from the beginning of large-scale work. They have many stories to tell, but none more amusing than their experiences with these condensers.

Today all the aluminum chloride is condensed in 16-inch iron pipes placed vertically. Revolving shafts and blades inside the pipes knock the aluminum chloride into hoppers as fast as condensed. The result is that the chemical is deposited in hoppers in the form of a powder, 75 per cent. or more passing a 10-mesh screen. This fineness permits drawing the aluminum chloride through a sliding door into iron drums or other convenient receptacles. If aluminum chloride is permitted to condense and solidify undisturbed, as was the case with the old brick condensers, it builds up into a solid rock-like mass, ultimately plugging the condenser no matter what the size. Aluminum chloride has been known to spud out of the brick condensers in chunks weighing several hundred pounds each. Aside from labor saving, the advantages of the present condensers over the old type can readily be appreciated. The life of an iron pipe condenser such as is here described is at least two years. This is surprising since there is always some hydro-

gen chloride and often a trace of free chlorine in the condensers, particularly if the charge of briquets is allowed to become too low. The reason for this long life is that the inside pipe walls become coated with a thin layer of aluminum chloride, which protects the iron from corrosion. Another item which adds to the longevity is the cooler, located between the chlorinating furnace and pipe condensers. Its object is to cool the aluminum chloride vapors to a temperature somewhat above their condensing temperature, thus increasing the capacity of the pipe condensers and minimizing the action of corrosive gases. This cooler is generally lined with a single course of fire brick. It also acts as a trap for any bauxite or carbon coming from the chlorinating furnace.

FURTHER IMPROVEMENTS PROMISED

Recent improvement in the manufacture of aluminum chloride by the Gulf Refining Company indicates the passing of the necessity for briquetting, substitutes refinery coke for coal, eliminates blasting the chlorinating furnace with air to restore heat, and seems to permit the enlargement of the furnaces to the size of, say, an iron blast furnace. Further, the charge of bauxite and coke is so distributed that practically no chlorine comes in contact with the shaft lining, thereby eliminating entirely the trouble to which reference has been made at some length in this paper. These facts have been established by experimental work on a large scale, and the plant is now being converted to this system. Further details regarding it can well form the subject of a future paper.

It will be the policy of the Gulf organization to make aluminum chloride available to the public for all uses as freely as possible in excess of Gulf's requirements and subjects to royalty when used in its patented process and apparatus for converting and refining petroleum and its products. It is their expectation that the present price of five cents per pound will shortly be lowered to even more attractive figures.

ACKNOWLEDGMENT

This development has not been a one-man job. It has required the combined efforts of many men pulling together, all of whom are now, or at some period have been, a part of the Gulf organization. Some may have spent more days and nights on the problems in the early years of development, and as a consequence, may have come into contact with more grief, but that does not matter now.

It seems fitting to mention one in particular, whose personality and leadership inspired others to overcome difficulties which many times seemed insurmountable—namely, George H. Taber, formerly vice president of Gulf Refining Company, who retired on December 31st last, after fifty-two years of notable service in the petroleum industry.

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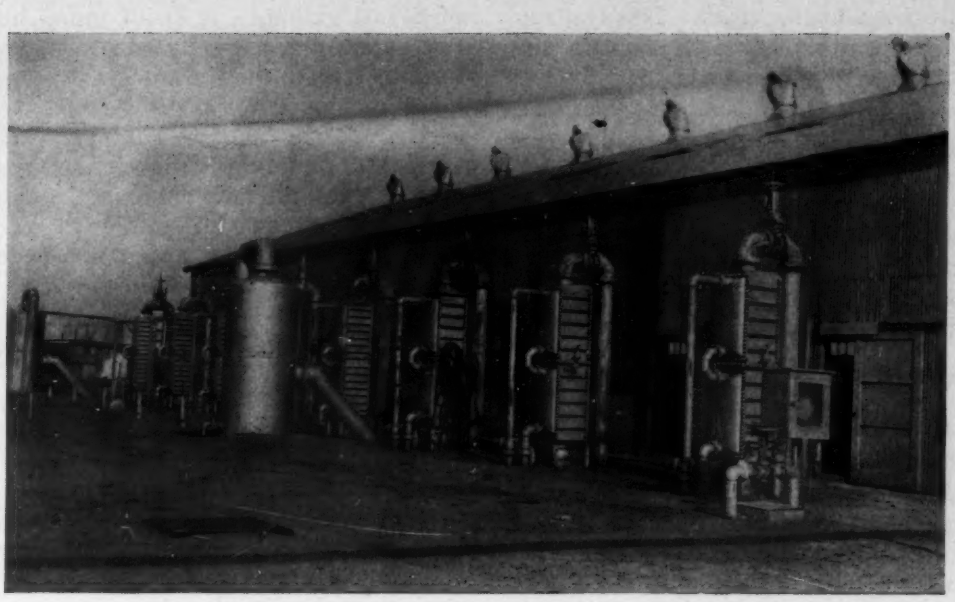
Schafer Ranch Plant Makes Two Grades of Natural Gasoline

By GEORGE REID

SKELLY Oil Company's Schafer ranch plant No. 1 in Carson County in the Texas Panhandle was built for permanent operation since field characteristics were indicative of a continued large volume of gas production. When a plant of large capacity was decided upon, company engineers designed the installation and constructed it so that it is an independent unit in itself, with water for steam and cooling from its own wells, and with electricity also produced by the plant's own generating plant. Further, such features as automatic control of processes and equipment were stressed and employed to such extent that plant operation may be carried on with the minimum number of workmen.

The plant has a rated capacity of 25,000,000 cubic feet of gas daily and has operated at 30,000,000 feet, producing around 25,000 gallons of gasoline. This installation differs from most gasoline plants in that two products are made continuously through the employment of the Skelly type of high pressure fractionator. The Schafer plant was the scene of the experimental work which lead to the perfection of equipment and processes for the manufacture of "Skelgas," the liquefied petroleum gas marketed by the company for household use. When the Schafer plant was producing "Skelgas" through its high pressure fractionating equipment it also made grades AA and BB natural gasoline. Since the installation of "Skelgas" equipment at Skelly Oil Company's Lyman, Oklahoma, plant the Schafer plant has confined its production to aviation gasoline and grade BB gasoline. The raw gsoline which is the source of the two grades mentioned is produced from the absorption plant and follows the cycle of condensers to run tanks, then to fractionator and to sour storage; then to treater for sweetening and to sweet storage.

The compression plant is equipped with eight 320 horsepower Worthington two-cylinder tandem type engines direct connected to Laidlaw 26X20 inches tandem compressors which have a rated capacity of four million cubic feet of gas daily, per machine. Gas boosted to absorption plant operating pressure is discharged



Water tube type of gas coolers installed adjacent to compression plant, giving straight line gas flow, compressors to absorption equipment

direct to eight individual Southwestern gas coolers which are installed on the outlet lines and adjacent to the compressor house. Before entering the five Tulsa type absorbers the gas is accumulated in a header line and taken through a large after-scrubber. The scrubber tank outlet conducts the gas directly to the absorber header line where it is diverted into the five tower inlet lines. The large compressor machines and the water tube type of gas coolers permit the erection of a more compact plant. The value of enclosed type of gas cooling system is obvious.

REGULATING AND CONTROL

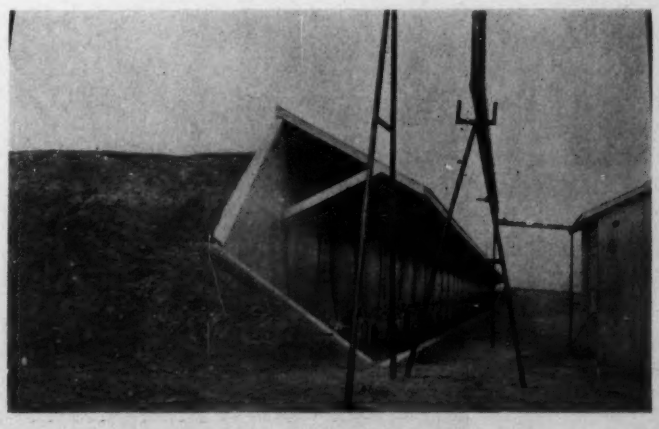
The five inlet lines conducting gas to the absorbers are each equipped with orifice plates to control the volume of gas entering each column. Differential pressures through the orifice plates are shown by Mariam manometers to afford means for the operators to check the gas flow. As a means of additional control the usual gate or block valves are provided in each of the inlet lines.

Similar regulation and control are applied to the lean oil which is circulated to the absorbers, and orifice plates are inserted in the lean oil lines. The size of orifices employed is accertained by the plant chemist and are based on test results employing the size orifice which will give the miximum oil saturation according to the gasoline content of the natural gas being treated.

Oil is circulated through the absorber equipment by Dean-Hill two-stage centrifugal pumps which are driven by Wagner electric motors. Fisher liquid level regulators are employed to maintain the required oil levels in the towers. The same type of regulator controls liquid levels in the stills.

Distillation equipment consists of three Type 75 Southwestern stills, preheaters and exchangers. All of this equipment is erected in a very compact manner and completely housed so that its operation is unaffected by cold weather. These distillation units may be operated as a single unit or separately, and are so manifolded or arranged that any single unit may be removed temporarily from the system without seriously impairing the efficiency of the plant as a whole. A Foxboro automatic flow controller is employed to regulate the flow of rich oil to each unit. This instrument is regulated by the plant chemist on the basis of saturation tests of the absorption oil. In operation each distilling unit is provided with the volume of rich oil per minute which the unit will efficiently strip. Foxboro automatic recorder temperature contorllers are provided for the careful regulation of the operating temperature of each still. It is through the utilization of these and several other instruments which give automatic control of plant processing that the labor overhead is reduced to the minimum at the plant, and the three men per shift, for the greater part of the time are required only to supervise the operation.

Gasoline leaving the condensers after distillation is accumulated in large stock tanks from which it is continuously withdrawn and subjected to refractionation



The side of a hill was utilized as the site for this battery of 30 Gasoline storage tanks, having a total capacity of 750,000 gallons

in the high pressure fractionating plant. This two column unit is provided with exchangers, reboilers and preheaters of Braun type.

At the time of the writer's visit the high pressure fractionator was employed to split the absorption plant gasoline production into two grades of gasoline—aviation and grade BB. Preheater temperature was constantly maintained at 330° F. with 200° F. held on the reflux cooler at the tower top, and operating pressure was 115 pounds per square inch. From this processing the two grades of gasoline are taken to "sour" storage.

CONTINUOUS TREATING

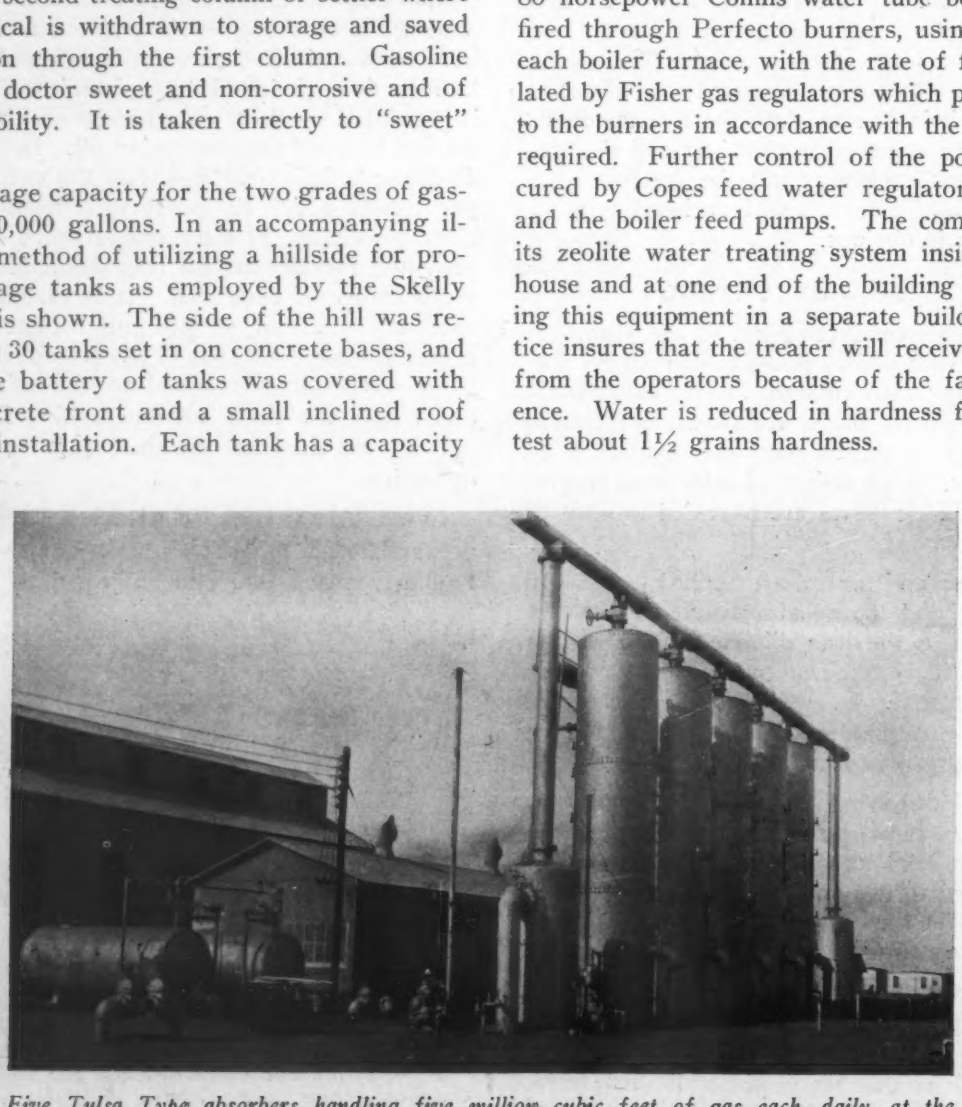
Sour gasoline is treated continuously employing sodium hychlorite solution as the treating agent. The gasoline is pumped through the treater; passing first into the No. 1 treating column where it is intimately mixed in an orifice plate mixing device, just outside of the column, with a weak solution of spent or once used hypochlorite solution. The treating column is reality a settler, from which the gasoline flows into a second mixing device or series of orifices where it is intimately mixed with fresh or strong hypochlorite solution. From this second mixer the gasoline and chemical solution passes into the second treating column or settler where the used chemical is withdrawn to storage and saved for recirculation through the first column. Gasoline thus treated is doctor sweet and non-corrosive and of good color stability. It is taken directly to "sweet" storage tanks.

"Sweet" storage capacity for the two grades of gasoline totals 750,000 gallons. In an accompanying illustration the method of utilizing a hillside for protection of storage tanks as employed by the Skelly Oil Company, is shown. The side of the hill was removed, and the 30 tanks set in on concrete bases, and then the entire battery of tanks was covered with earth. A concrete front and a small inclined roof completed the installation. Each tank has a capacity of 25,000 gallons. A small pump house containing two steam pumps is placed nearby, one pump being used to handle the lighter grade of gasoline and the other employed for transferring only aviation gasoline to the loading rack. The location of storage tanks and pumping station is well removed from the plant proper and isolated from the danger zone. Also, should any fires or leaks occur at the storage battery the plant equipment would not be endangered, for any flowing gasoline would only be removed further from the plant.

ELECTRIC POWER PLANT

The plant is provided with its own electricity generators which are 125 K. V. A. General Electric type, direct connected to three, four cylinder, 200 horsepower Hope engines of vertical type. This plant generates electricity for use as power to drive many pumps about the plant yard, and to light the plant and nearby camp. Electricity is also provided for the Skelly Oil Company's production department on the Schafer ranch and at the charcoal type absorption plant about three miles west. Power is also provided for the Cabot Company's carbon black plant at Skellytown.

The steam power plant at the plant consists of four 80 horsepower Collins water tube boilers. They are fired through Perfecto burners, using six sections in each boiler furnace, with the rate of firing being regulated by Fisher gas regulators which permit gas to flow to the burners in accordance with the volume of steam required. Further control of the power plant is secured by Copes feed water regulators on each boiler and the boiler feed pumps. The company has erected its zeolite water treating system inside of the power house and at one end of the building instead of isolating this equipment in a separate building. This practice insures that the treater will receive better attention from the operators because of the factor of convenience. Water is reduced in hardness from 19 grains to test about 1½ grains hardness.



Five Tulsa Type absorbers handling five million cubic feet of gas each, daily, at the Schafer No. 1 plant of Skelly Oil Company at Skellytown, Texas

Oil to Gas Ratios in Natural Gasoline Absorption Plants*

By E. R. COX[1] and M. L. ARNOLD[2]

THE object of this investigation was to find a relation, if possible, between the oil to gas ratio, together with the other working conditions of an absorber, and the efficiency of the absorber in recovering gasoline. To do this we first worked out a formula which would theoretically express this relation, secured as much as possible on the active performance of absorbers, checked the data against the formula, and finally arrived at a modified formula which we believe adequately represents the performance investigated.

THEORY OF ABSORPTION

Since the absorption of gasoline in oil is a solution process we would naturally look to the law of perfect solutions or Raoult's Law for the basis of our formula. This law states that the partial pressure of any component in a perfect solution is equal to the product of its mol fraction in the solution times the pressure it would exert at the same temperature in a pure state.

If we call the mol fractions, x_1, x_2, x_3, and in general x_n, for methane, ethane, propane and in general component "n" respectively, and the pressures of the pure components p_1, p_2, p_3, and p_n respectively, the partial pressures will be $x_1\ p_1$, $x_2\ p_2$ —$x_n\ p_n$. These are the partial pressures in the liquid. In the gas the partial pressures are divided in accordance with Dalton's Law. If P is the total or working pressure (absolute), and y_1, y_2, y_3, etc., represent the composition of the gas (by volume), then the partial pressures in the gas are, $y_1\ P$, $y_2\ P - y_n\ P$. If the liquid is in perfect equilibrium with the gas, the partial pressures are equal for each component, or $x_1\ p_1 = y_1\ P_2$, $x_2\ p_2 = y_2\ P$ or in general $x_n\ p_n = y_n\ P$—(1).

By definition, $x_n = L_n/L$ and $y_n = V_n/V$ where L_n and V_n are the number of mols of component "n" in the liquid and gas respectively, and L and V are the total mols of liquid and gas. Substituting these values in equation 1, we have,

$$\frac{L_n\ p_n}{L} = \frac{V_n\ P}{V}$$

Multiplying both sides of this equation by $L/V_n\ p_n$, it becomes

$$\frac{L_n}{V_n} = \frac{L\ P}{V\ p_n} \text{—(2)}$$

This is a very useful equation, and applies to any process where the total liquid plus vapor is constant throughout and the two are in equilibrium — such as flash distillation and most cases of condensation.

In the case of absorption we know P, the total pressure, and can obtain p_n, the vapor pressure of each component, from the working temperature and a table or chart. Then if we know L/V or the ratio of total liquid to total vapor, we can calculate L_n/V_n for each component. We are not particularly concerned with this ratio at different trays, but we are vitally concerned with it at the bottom of the absorber. If we had a perfect absorber, the wet gas entering and the fat oil leaving the absorber would be in exact equilibrium and L_n/V_n would be the recovery ratio for each component. For example, if L_3/V_3 were found to be 0.3 for propane, it would indicate that for every ten mols of propane in the wet gas there would be only three mols in the fat oil, hence we would be recovering .3 or 30% of the propane. In the same way we may calculate the recovery fraction for each component, merely substituting in the formula the proper value of p_n. If the value of this fraction is greater than unity, as in general it will be for pentane and heavier, it merely means that the oil circulated could not be saturated with this component at the given temperature and pressure.

CALCULATING TOTAL ABSORPTION

To render this a convenient working formula, it is necessary to translate L/V into terms of oil gas ratio. This ratio is expressed as gallons of lean absorbent oil per thousand cubic feet of wet gas. Calling this R_o, the weight would be $8.33\ R_oG_o$ where G. is the specific gravity of the oil, and since a mol is "m" lbs. where "m" is the molecular weight of a substance, the mols of absorbent oil would be $8.33\ R_oG_o/m$. If we call the gasoline absorbed "A" in gals. per thousand cubic feet, this would be $8.33\ AG_a/m_a$ in mols. Hence $L = 8.33\ R_oG_o/m_o + 8.33\ AG_a/m_a$. The mols of gas in 1000 cu. ft. are obtained from Avogadro's Law, namely, that the densities of all gasses at a given temperature and pressure are proportional to their molecular weights. Hence, at the same temperature and pressure a mol of gas is a constant volume. At 60° F. and atmospheric pressure this constant is approximately 379 cu. ft. or $V = 1000/379 = 2.4$ mols. Hence $L/V = (8.33\ R_oG_o/m_o + 8.33\ AG_a/m_a)\ /2.4 = 3.153\ (R_oG_o/m_o + AG_a/m_a)$. If we call the recovery fractions F_1, F_2, F_3, etc., the formula becomes,

$$F_n = 3.153\ (R_oG_o/m + AG_a/m_a)\ P/p \ldots\ldots (3).$$

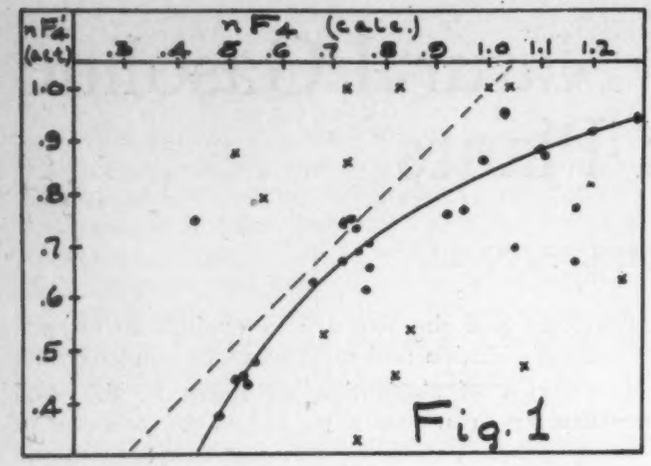
To calculate the total absorption term AG_a/m_a, three methods are offered.

(1) Where wet and dry gas tests are available. Here the method is comparatively simple. Since the propor-

*Read before July meeting of the California Natural Gasoline Association.

[1]=The Texas Company.

[2]=Richfield Oil Company.



tion of methane absorbed is practically negligible, we may assume that there is the same amount of methane in the dry gas as in the wet gas. If we call the total wet gas W, the total dry gas D, the methane analyses W_1 and D_1, and the total absorption in cu. ft., A_o, the latter is the shrinkage or $A_o = W\text{-}D$. the methane in the wet gas is W_1W and in the wet gas D_1D. Equating these, combining the two equations and solving for A_o, we have,

$$A_o = \frac{(D_1 - W_1)}{D_1} \text{ or for } W = 1000 \text{ cu. ft.}$$

$$A_o = \frac{1000\ (D_1 - W_1)}{D_1} \ldots\ldots\ldots (4)$$

To express this in terms of gals. per thousand, we have,

$$A_o = \frac{8.33\ AG_a}{m_a} \times 379 \text{ or } \frac{AG_a}{m_a} = \frac{A_o}{3160}$$

Substituting in Eq. 4.

$$\frac{AG_a}{m_a} = \frac{.316\ (D_1 - W_1)}{D_1} \ldots\ldots\ldots (5)$$

(2) Where no analyses are available we may assume that the vapor pressure of the total absorption is approximately that of propane. The empirical equation would be,

$$\frac{AG_a}{m_a} = C\ \frac{R_oG_o}{m_o}\ P_3 \ldots\ldots\ldots (6)$$

Using the data in Tables I and III, and calculating C, the mean value was found to be .323. This is probably accurate enough for estimating.

(3) Ordinarily R_oG_o/m_o is 8 or 10 times as large as AG_a/m_a, hence a small error in estimating the latter does not greatly affect the result. If we assume a constant ratio between the two, the general formula is considerably simplified. The mean value of R_oG_o/m_o for all the tests was 0.1716 and the mean for AG_a/m_a was 0.0216 or

$$AG_a/m_a = 0.126\ R_oG_o/m_o \ldots\ldots (7)$$

Substituting this value in Eq. 3, we have

$$F_n = \frac{3.55\ R_oG_oP}{m_op_n} \ldots\ldots\ldots (8)$$

We believe this formula is sufficiently accurate for the usual temperatures and pressures. For extreme cases, Eq. 6 is preferable.

ABSORPTION TESTS AND CALCULATIONS

A questionnaire was sent out to the principal companies operating absorption plants, asking for the data covered in Table I and II. They responded very generously and 45 tests were reported. Two of these, Nos. 35 and 36, could not be used for testing the formula, since gas analyses were not included. They are listed, however, to show oil rates in use at high pressures. Two other cases, Nos. 14 and 16, are omitted as being quite unreliable. In eight other cases the wet and dry gas analyses are inconsistent, inasmuch as more of one component, after allowing for shrinkage, is shown in the dry gas than in the wet, which, of course, is impossible. This tends to throw doubt upon the analyses of the other components. Other tests are questionable on account of the extremely high total absorption indicated by the methane analyses, without a corresponding rise in temperature of the oil. All of the tests concerning which there is any question have been marked with an interrogation point in Table III. Many of these, however, plot quite consistently for the most important components, normal butane and pentane plus, while many others in which there is no definite inconsistency in the analysis may be equally in error. The point we wish to make is the complete agreement between actual and calculated recovery must not be expected. The best we can hope for from the present data is a general average. We have no reason to question the accuracy of the analysis, but believe the inconsistencies shown are due to the methods of sampling. We know that the composition of a gas is constantly changing. Even if samples are taken simultaneously, if a change is taking place or has just taken place in the gas, the samples will not be representative since it takes some time for the oil to reach equilibrium with the changed gas. In this connection, we would strongly suggest the advisability of installing sampling tanks in which composite samples are collected over a period of three or four hours, or even for the whole twenty-four hours.

Table I shows the principal data, and, in general, is self-explanatory. In the column headed m_o/G_o, values of molecular weight were used as furnished. Where no value was given in the report, we used that corresponding to the nearest gravity of some tested oils.

Table II gives the wet and dry gas analyses as reported and Table III the calculated results. In the second column AG_a/m_a was calculated as follows: Since Eq. 5 gave values which seemed extreme in many cases this term was calculated by both Eq. 5 and Eq. 6 and the mean of the results taken. The next three columns are the calculated recovery for propane, isobutane and normal butane. These were calculated from Eq. 3 and indicate what would be recovered with a perfect tower and 100% equilibrium. In the next three columns are listed the actual recovery of these three fractions, which are calculated as follows: Since the analyses of the dry gas is so many cubic feet of each fraction per hundred cubic feet of dry gas this does not correspond to one hun-

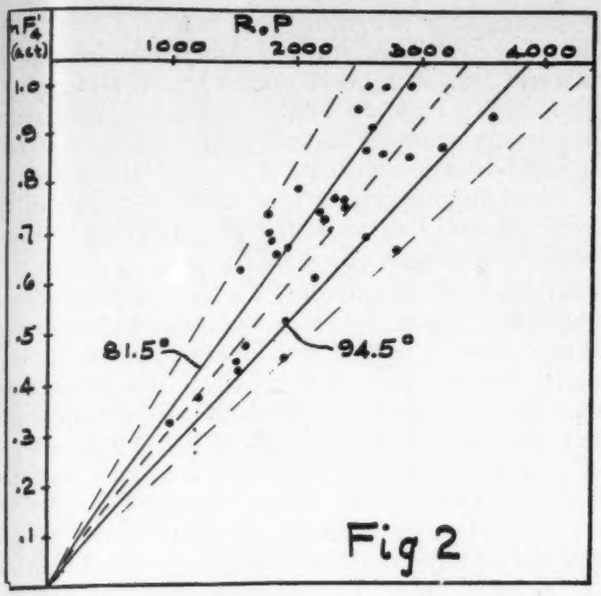


Fig 2

dred cubic feet of wet gas but must be adjusted to the same basis, as follows: Calling the actual fraction recovered F'_n to distinguish it from the calculated value F_n, we have

$$F'_n = \frac{W_n - D_n \overline{D_1}}{W_n}$$

This may be demonstrated by taking a case—Test No. 1. Assuming the methane absorption is negligible, total wet gas is to total dry gas as 92.1:85.3, or for each 100 cubic feet of wet gas we have 100 x 85.3/92.1 = 92.6 cubic feet of dry gas. The dry gas analyses of propane is 4.50%. 4.50% of 96.6=4.16. The wet gas analysis of propane is 6.80%. Hence, for each 100 cubic feet of wet gas we had 6.8 cu. feet of propane and this shrunk to 4.16 cubic feet, or 2.64 cubic feet was absorbed. The fraction recovered was 2.64/6.80 = .388 or 38.8%.

The next three columns are obtained by dividing the actual fraction absorbed by the calculated fraction and represent the absorption efficiencies, or more strictly, the degree of equilibrium established between incoming gas and outgoing oil. This is quite different for each component and, hence, cannot in general be called "absorber efficiency."

The tables are far too long to read but each column has been averaged with the following results: The typical lean oil is 40° A.P.I., has a molecular weight of 187, a saturation of 1¾% at 375°F. and a vapor

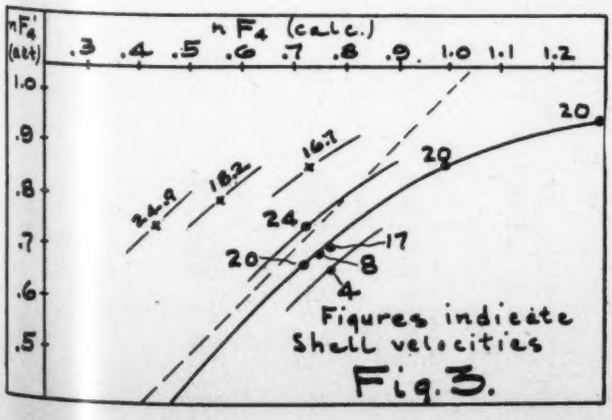


Fig. 3.

pressure of 27.mm at 80°F. The average working pressure is 70 lb. gage. The oil enters at 72.4°F and leaves at 88.6°F., or the mean rise is 16.2°F. The oil to gas ratio is 38.8 gals. per thousand cu. ft. The shell velocity is 28.5 ft. per min. corrected to the bottom oil temperatures. The average gas analyses are:

	Wet Gas	Dry Gas
Mehane	79.80%	85.90%
Ethane	6.48	6.31
Propane	6.22	7.74
Isobutane	1.35	0.78
Normal Butane	2.33	0.69
Pentane Plus	2.97	0.16

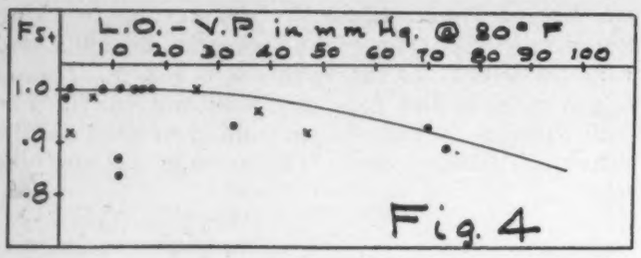
The mean recoveries and efficiencies are:

	Calculated	Actual	Efficiency
Propane	22%	28	129
Isobutane	57	49	86
Normal Butane	84	70	83
Pentane Plus	..	92	92

The 129% comes with a shock and has caused some lively argument as to whether we could have an efficiency of over 100%, or in other words whether the oil could leave the absorber supersaturated with one component. We believe that it can and offer the following argument: In the upper trays the oil is saturated with the lighter fractions until its total vapor pressure is equal to the working pressure. As it travels downward, these must be driven off and replaced by heavier fractions. If our trays were 100% perfect as fractionators the replacement would be complete and the oil would leave the absorber exactly in equilibrium with the entering gas. Since, however, our absorber is not efficient as a fractionator, the excess propane is not driven off but leaves in the fat oil. It is quite possible that much of

TABLE I—PRINCIPAL DATA

Test No.	Perf or B.C.	L. O. °API	L. O. m/G	L. O. @375°	L. O. V. P.	P(abs.) lb sq in	Top °F.	Bott. °F.	Bott. R_n	Shell Veloc.
1	Perf.	39.2	215	...	...	58.7	71	92	40	60.0
2	"	39.2	215	...	...	56.7	77	98	27	59.7
3	"	41.2	187	...	...	52.7	79	96	23	62.7
4	"	40.0	203	...	...	190.0	60	98	10.1	35.5
5	"	38.5	226	...	...	48.7	63	80	37.4	4.0
6	"	38.5	226	...	...	47.7	66	76	37.7	8.2
7	"	38.5	226	...	...	47.7	65	80	37.4	16.6
8	"	38.5	226	...	11.0	47.7	66	82	37.0	24.2
9	"	38.5	226	...	11.0	44.7	68	81	55.5	14.8
10	B. C.	38.5	226	...	11.0	45.7	69	83.5	52.2	24.9
11	Perf.	34.6	283	...	...	54.7	80	98	37.0	18.2
12	"	37.7	238	...	...	51.7	84	90	37.0	16.9
13	"	39.0	219	2.50	70.0	46.7	74	92	46.0	19.5
15	"	38.8	222	1.70	33.0	63.7	82	96	35.0	27.7
17	"	37.2	245	.94	47.0	51.7	94	98	79.0	24.8
18	"	40.8	192	.67	73.0	54.7	82	90	47.0	32.2
19	"	35.6	269	3.00	38.0	52.7	83	101	55.0	16.7
20	"	35.2	274	.47	17.0	51.7	73	77	52.0	25.3
21	B. C.	36.0	263	2.80	168.0	315.0	79	106	12.0	19.8
22	Perf.	38.0	233	.22	1.0	47.7	69	83	50.1	51.3
23	B. C.	38.9	204	3.38	14.0	70.7	70	101	22.7	48.3
24	"	38.6	204	3.50	17.0	72.7	69	102	20.9	56.0
25	Perf.	38.7	200	.96	16.0	52.7	80	84	48.3	16.3
26	"	36.6	197	1.27	26.0	57.7	73	82	30.4	27.1
27	"	39.0	219	4.00	...	44.7	75	85	74.0	38.3
28	"	37.0	248	2.00	...	42.7	71	81	67.8	14.0
29	"	36.0	263	1.50	...	43.7	76	82	49.4	26.1
30	B. C.	41.5	189	...	2.0	74.7	64	120	34.7	21.6
31	"	35.2	209	...	2.0	72.7	64	86	35.7	18.4
32	Perf.	34.3	213	...	8.5	106.7	79	97	29.5	17.0
33	"	35.3	208	...	10.0	335.0	69	76	3.0	26.9
34	B. C.	43.0	182	...	6.0	72.7	68	113	21.1	29.3
35	Perf.	39.6	...	...	...	365.0	65	63	5.0	14.8
36	"	39.4	...	...	...	365.0	55	58	3.8	16.5
37	"	34.7	211	1.10	...	42.7	80	98	35.9	27.1
38	"	35.1	210	.78	...	44.7	59	73	51.5	15.8
39	"	34.4	212	.90	...	41.7	70	84	67.5	49.8
40	"	34.8	210	.73	...	54.7	75	83	28.2	30.0
41	"	36.7	241	...	...	49.7	64	81.5	38.5	20.4
42	"	36.7	241	...	...	49.2	70	84	54.4	20.6
43	"	36.7	241	...	...	49.2	74	85	72.4	20.6
44	"	34.8	265	2.17	1.9	53.7	80	100	31.4	24.9
45	"	34.8	265	2.17	1.9	53.7	80	96	36.3	17.6
Mean	..	39.9	226	1.75	26.6	84.9	72.4	88.6	38.8	27.0



the light fractions are forced out of solution but mechanically entrained in the form of very fine bubbles which do not have time to separate out from the oil.

ABSORBER TRAYS TESTED

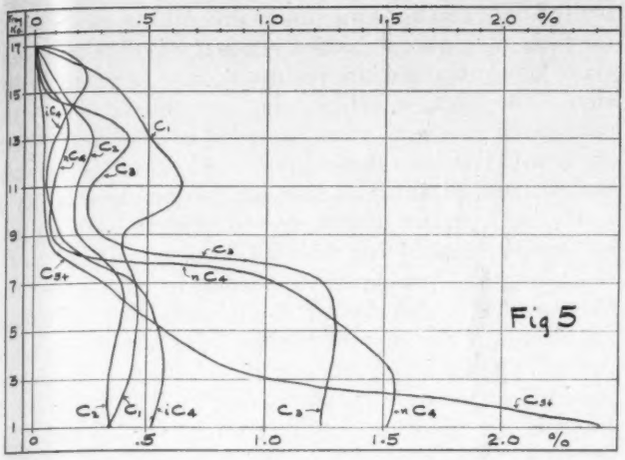
In an endeavor to find out what happens at different levels of an absorber, a series of tests were made upon one absorber taking samples of both oil and gas over the odd numbered trays from 1 to 15, numbering up from the bottom. The results are tabulated in Table VI and are charted in Figures 5 to 9. Fig. 5 shows per cent. of each fraction absorbed. In Fig. 6 partial pressures in oil and gas are compared for isobutune, normal butane and the pentanes combined. The full lines indicate partial pressures in the oil; dotted lines in the gas. Fig. 7 shows the same for ethane and propane and Fig. 8 for methane. The temperature gradient is indicated in Fig. 9. These curves are very interesting but not very conclusive. There is general conformity between the gas and oil pressures but some very confusing crossing of the lines. These seem to indicate unstable equilibrium and surging or oscillation. We can find no reason for the rapid change which takes place at about the center of the column, unless it is due to a change in the composition of the gas which was occurring at about the time the samples were taken.

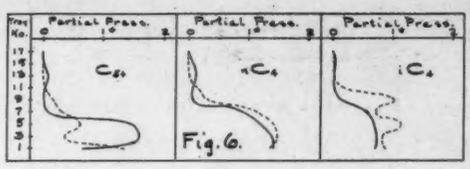
Several years ago—before the days of fundamental analyses—a similar test was run upon an absorber by taking samples of oil at different trays, running Englers upon them and plotting the percentages given off at different temperatures against tray number. This showed a rapid absorption at top and bottom for all fractions. The light fractions remained nearly constant in the intermediate trays, only the heaviest showing gradual absorption throughout. This seems quite different from the present case and also suggests that the composition of the gas may have been changing.

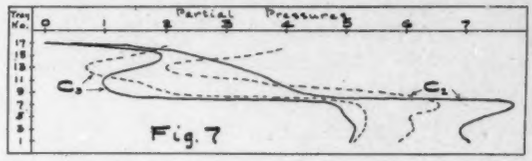
Returning to the main tests, we may say that the recovery of normal butane is the most important function of an absorber. We don't want the lighter fractions and their absorption may be looked upon as a necessary evil, while the fractions heavier than butane take care of themselves. That is to say, if we

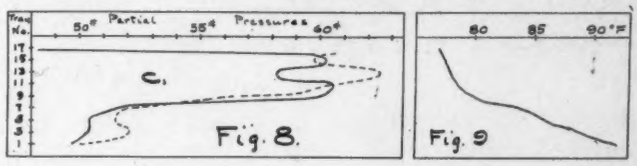
TABLE II—GAS ANALYSES

Test No.	WET GAS CH_4	C_2H_6	C_3H_8	$^iC_4H_{10}$	$^nC_4H_{10}$	C_5H_{12}	DRY GAS CH_4	C_2H_6	C_3H_8	$^iC_4H_{10}$	$^nC_4H_{10}$	C_5H_{12}+
1	85.30	1.60	6.80	1.50	1.40	3.40	92.10	1.90	4.50	0.60	0.70	0.20
2	84.50	2.80	4.80	1.10	1.40	2.30	94.50	0.90	2.60	0.90	0.90	0.20
3	79.60	6.00	7.00	2.10	2.40	1.10	85.00	5.30	5.80	1.00	1.60	0.10
4	90.20	1.80	4.30	0.90	1.20	1.60	96.10	0.70	0.70	1.80	0.70	0.00
5	77.61	8.67	7.48	1.35	2.35	2.54	82.97	6.95	8.45	0.77	0.86	0.00
6	77.73	8.85	7.39	1.05	2.56	2.42	82.42	8.76	6.56	0.85	0.85	0.56
7	76.12	9.11	7.03	1.52	2.30	3.92	82.56	8.97	6.49	0.76	0.74	0.48
8	75.76	9.62	7.91	1.48	2.46	2.77	81.52	9.70	6.76	0.84	0.69	0.49
9	76.44	9.60	7.70	1.52	2.35	2.39	85.85	7.31	5.95	0.77	0.12	0.00
10	75.53	9.38	8.18	1.23	3.08	2.60	82.21	9.15	6.75	0.74	0.77	0.38
11	71.00	8.00	9.10	2.50	3.30	3.90	82.40	8.00	6.30	0.70	0.80	0.30
12	82.70	4.70	5.60	1.20	2.40	3.10	86.80	4.50	6.00	1.00	1.20	0.20
13	74.90	5.40	9.60	2.50	3.30	3.70	81.70	7.30	7.60	1.20	1.40	0.30
15	78.70	5.30	7.10	1.40	2.50	2.70	84.70	5.60	5.90	0.60	0.70	0.20
17	81.90	6.40	5.00	1.30	2.10	2.50	87.90	4.10	5.40	0.90	1.20	0.20
18	78.50	7.00	6.60	1.30	2.50	2.60	82.80	7.30	5.30	0.70	0.80	0.30
19	70.00	5.90	5.70	2.30	3.10	9.90	76.70	10.50	8.80	1.10	0.50	0.40
20	79.60	1.60	4.50	1.90	2.80	2.90	79.60	7.60	5.10	0.60	0.00	0.00
21	81.90	6.33	4.82	1.16	2.13	3.65	88.15	6.06	4.48	0.57	0.42	0.32
22	78.71	7.82	6.59	1.07	2.74	3.07	84.75	8.42	5.46	0.60	0.71	0.06
23	80.74	8.58	4.98	1.01	1.87	2.82	86.56	7.09	4.35	0.95	1.05	0.00
24	80.69	8.14	5.23	0.93	1.99	3.02	85.75	7.65	4.59	0.83	1.18	0.00
25	87.82	3.92	4.03	0.73	1.75	1.75	93.66	2.54	3.16	0.39	0.25	0.00
26	86.97	4.33	3.99	0.89	1.66	2.16	92.72	3.52	3.12	0.64	0.00	0.00
27	80.30	6.84	5.72	0.85	2.40	3.89	83.29	8.02	6.49	1.29	0.91	0.00
28	82.04	7.38	5.17	0.95	1.81	2.65	84.10	8.94	5.66	1.30	0.00	0.00
29	84.66	6.35	4.49	0.74	1.48	2.28	87.96	6.49	4.30	0.52	0.40	0.33
30	74.64	8.26	7.54	1.55	3.23	4.78	86.05	8.05	5.58	0.27	0.00	0.04
31	64.27	14.32	10.77	2.90	3.83	3.90	81.50	9.51	7.75	0.83	0.41	0.00
32	82.18	3.93	6.71	1.16	3.47	2.55	90.16	3.77	5.13	0.47	0.47	0.00
33	89.00	4.31	5.19	0.66	0.71	0.13	92.44	2.22	4.19	0.50	0.50	0.16
34	79.25	7.30	5.78	1.51	2.51	3.65	87.95	6.07	4.84	0.56	0.35	0.07
35	....	...	...	...	...	...	....	...	...	...	...	...
36	....	...	...	...	...	...	....	...	...	...	...	...
37	74.70	8.00	8.60	1.30	3.40	4.00	78.40	8.10	8.90	1.30	2.70	0.60
38	70.80	5.60	2.90	1.40	1.60	3.70	77.30	5.20	2.60	0.50	0.40	0.00
39	74.60	9.10	7.80	1.60	3.00	3.90	82.40	8.40	6.60	1.30	1.10	0.20
40	86.80	4.30	4.50	0.70	1.80	1.90	91.10	3.40	3.80	0.80	0.70	0.20
41	78.64	7.87	7.59	1.20	2.30	2.40	81.74	9.93	6.79	0.69	0.79	0.06
42	74.83	9.63	8.45	1.59	2.92	2.58	82.53	9.20	7.11	0.71	0.45	0.00
43	74.53	10.00	8.12	1.59	3.08	2.68	84.21	9.23	6.06	0.28	0.22	0.00
44	93.54	0.64	1.71	0.91	1.10	1.90	97.50	1.12	0.57	0.16	0.29	0.16
45	93.54	0.64	1.71	0.91	1.10	1.90	96.76	1.13	0.52	0.52	0.63	0.24
Mean	79.80	6.48	6.22	1.35	2.33	2.97	85.90	6.31	7.74	0.78	0.69	0.16









choose an oil rate that will absorb substantially all the normal butane we require, it will be ample to recover the pentane and heavier fractions. The most important condition necessary to recover all the pentane plus, seems to be a good stripping of the lean oil. This is shown quite clearly in Fig. 4 where actual recovery of pentane plus is plotted against vapor pressure of the lean oil in mm Hg. at 80°F. No complete recovery of pentane plus is recorded for a vapor pressure of over 27. mm. and all but one fall under 20. mm. It would also seem that there is no advantage in stripping down to 1. or 2. mm. If we cannot recover all of this fraction with 20. mm. oil, the fault probably lies in the absorber. Pentane recovery was also plotted against saturation at 375° and butane recovery against saturation at 375° and against vapor pressure. Neither of these showed any clear indication.

NORMAL BUTANE RECOVERY

In Fig. 1 actual vs. calculated recoveries of normal

TABLE III — CALCULATIONS

Test No.	A	Calc. Recovery			Actual Recovery			Absorption Efficiencies				
	m_a/G_4	F_3	$_iF_4$	$_nF_4$	F'_3	$_iF'_4$	$_nF'_4$	E_3	$_iE_4$	$_nE_4$	E_5+	
1	.022	.23	.59	.85	.388	.633	.536	168	107	63	94	?
2	.023	.15	.37	.53	.514	.272	.429	343	73	81	92	
3	.016	.13	.33	48	.224	.556	.375	172	168	78	91	
4	.018	.22	.57	.82	.847	..	.450	385	...	55	100	?
5	.019	.20	.52	.77	...	.46.	.657	...	90	85	100	?
6	.018	.21	.54	.75	.162	.142	.687	77	26	91	78	
7	.022	.20	.52	.77	.148	.540	.700	74	104	91	89	
8	.020	.19	.49	.72	.205	.473	.740	119	96	103	84	
9	.029	.26	.70	1.03	.311	.550	.952	120	78	95	100	
10	.024	.24	.64	.95	.240	.447	.767	100	70	81	87	
11	.030	.15	.39	.56	.415	.760	.790	276	195	141	93	?
12	.015	.18	.46	.68	...	.208	.524	...	45	77	94	?
13	.023	.20	.52	.76	.275	.560	.612	137	108	80	93	
*15	.021	.20	.51	.74	.200	.586	.731	100	114	98	93	
*17	.026	.31	.79	1.14	.102	.353	.467	33	45	47	92	?
18	.020	.28	.72	1.05	.240	.492	.693	85	68	69	89	
19	.024	.20	.51	.73	...	.565	.853	...	111	117	96	?
20	.024	.25	.67	1.00	...	.704	1.000	...	105	100	100	?
21	.022	.29	.84	1.20	.134	.543	.815	46	65	81	92	?
22	.023	.24	.64	.92	.231	.477	.756	96	74	82	98	
23	.018	.15	.38	.55	.185	.119	.477	123	31	87	100	
24	.016	.14	.36	.51	.174	.160	.442	124	44	87	100	
25	.023	.29	.76	1.11	,266	.482	.867	92	65	87	100	
26	.019	.21	.56	.82	.267	.325	1.000	127	58	120	100	?
27	.022	.33	.86	1.26	...	...	.633	...	...	53	100	?
28	.017	.27	.71	1.04	...	...	1.000	...	...	100	100	?
29	.014	.19	.50	.73	.080	.324	.743	42	65	102	86	
30	.032	.21	.52	.73	.358	.852	1.000	170	163	137	92	?
31	.043	.31	.82	1.20	.433	.776	.917	140	95	92	100	
32	.024	.30	.77	1.11	.302	.629	.876	101	82	88	100	
33	.010	.19	.51	.75	.222	.273	.324	117	53	43	0	?
34	.024	.14	.36	.51	.246	.668	.873	176	186	171	98	?
35	...	...	...	...	...	...	....	...	...	...	...	
36	...	...	...	...	...	...	....	...	...	...	...	
37	.014	.14	.35	.55	.015	.046	.244	10	13	44	85	?
38	.027	.29	.79	1.17	.180	.670	.770	62	85	77	100	
39	.029	.30	.80	1.17	.234	.262	.667	78	33	67	95	
40	.015	.17	.45	.66	.195	...	.627	115	...	95	90	?
41	.015	.18	.49	.72	.140	.450	.670	78	92	93	98	?
42	.026	.26	.67	.99	.237	.597	.860	91	89	87	100	
43	.034	.34	.88	1.29	.340	.843	.940	100	95	94	100	
44	.013	.12	.30	.43	.679	.835	.745	570	276	171	92	
45	.011	.14	.36	.52	.707	.451	.445	502	124	85	88	
Mean	.022	.22	.57	.84	.283	.489	.699	147	89	90	92	
						Mean F'_n/mean F_n=		129	86	83		

$x_n p_n = y_n P$ ..... (1) $\quad x_n = \frac{L_n}{L} \quad y_n = \frac{V_n}{V}$

$\frac{L_n p_n}{L} = \frac{V_n P}{V}$ or $\frac{L_n}{V_n} = \frac{L P}{V p_n}$ ---(2)

$\frac{\text{Oil}}{\text{Gas}} = \frac{R_0 \text{(gals)}}{1000 \text{ (cu ft)}} \quad R_0 = \text{(gals)} = 8.33 R_0 G_0 \text{ (lbs)} = \frac{8.33 R_0 G_0}{m_0} \text{(mols)}$

$A \text{ (gals)} = \frac{8.33 G_a}{m_a} \text{ (mols)} \quad L = \frac{8.33 R_0 G_0}{m_0} + \frac{8.33 A G_a}{m_a}$

$V = \frac{1000}{379} = 2.4 \text{ (mols)} \quad \frac{L_n}{V} = 3.153 \left(\frac{R_0 G_0}{m_0} + \frac{A G_a}{m_a} \right)$

Call $\frac{L_n}{V_n} = F_n \quad \therefore F_n = 3.153 \left(\frac{R_0 G_0}{m_0} + \frac{A G_a}{m_a} \right) \frac{P}{p_n}$ ---(3)

To find "A" — (1) $\frac{A G_a}{m_a} = \frac{.316 (O. - W.)}{10.}$ (5) (O. & W. = Dry and Wet Gas Analyses of Methane)

(2) $\frac{A G_a}{m_a} = \frac{.323 R_0 G_0 P}{m_0 p_0}$ ... (6)

Approximately (1) $F_n = \frac{3.55 R_0 G_0 P}{m_0 p_n}$ .... (8)

(2) $F_{nc} = \frac{.0133 R_0 P}{p_{nc}}$ .... (9)

Or for $F_{nc} = 1$. $\quad R_0 = \frac{75 p_n}{P}$ .... (10)

Fig. 10

butane are plotted, the questionable points being marked with a cross. Even disregarding these, the points are pretty well scattered, showing a wide divergence in efficiency for different absorbers. However, the average is clearly enough defined to conclude that with the common absorber a recovery of 80—85% of the normal butane is all that can be expected, no matter how high the oil to gas ratio is carried. A high calculated recovery is due to a high oil to gas ratio and the results do not seem to justify this. The highest efficiencies are shown where the calculated recovery runs from .40 to .80. Eight tests show efficiencies ranging from 102 to 171% for normal butane. Making all allowances for uncertainty of analysis, it seems demonstrated that the fat oil may be supersaturated for normad butane as well as for isobutane and propane. As shown in Fig. 5, most of the pentane is absorbed in the bottom tray. If it does not drive off the surplus butane here it will remain in the oil. Even if forced out of solution it might be retained as very fine bubbles mechanically entrained. Even if the oil were supersaturated for all the components from ethane up, its total vapor pressure could still be well within the working pressure. According to the tray to tray tests (Table IV) methane makes up 76 to 92% of the total pressure of the oil, assuming that this is the working pressure. Unfortunately, we cannot calculate the partial pressure of the absorbed methane, without extrapolating its vapor pressure curve far beyond the critical point.

TABLE IV—FIRST GROUP

Test No.	t°F	R_0P	$_nF^1_4$
5	80	1820	.657
6	76	1800	.687
7	80	1790	.700
8	82	1760	.740
9	81	2480	.952
10	83	2380	.767
15	96	2230	.731
20	77	2690	1.000
22	83	2390	.756
25	84	2550	.867
28	81	2900	1.000
29	82	2160	.743
31	86	2600	.917
33	76	1000	.324
38	73	2300	.770
40	83	1540	.627
41	81	1920	.670
42	84	2680	.860
Mean	81.5	2167	.764
$_nP_4$ = 38 lbs			
C = .0134			

TABLE V—SECOND GROUP

Test No.	t°F	R_0P	$_nF^1_4$
2	98	1530	.429
3	96	1220	.375
4	98	1920	.450
12	90	1910	.524
13	92	2150	.612
18	90	2570	.693
19	101	2900	.853
23	101	1600	.477
24	102	1520	.442
32	97	3150	.876
39	84	2810	.667
43	85	3570	.940
Mean	94.5°F	2240	.611
$_nP_4$ = 47 lbs			
C = .01283			
Mean of 30	86.7	2195	.7035
$_nP_4$ = 41.4 lbs			
C = .01328			

TABLE VI
Gas Analysis (By Vol.)

Tray No.	1	3	5	7	9	11	13	15
C	77.32	78.66	77.90	78.84	85.95	92.10	95.51	91.81
C	9.11	9.29	9.18	9.97	8.59	5.17	3.09	5.27
C	7.94	8.05	8.09	7.95	3.12	2.16	1.05	2.27
C	1.34	1.22	1.72	1.08	1.59	.27	.07	.12
C	2.15	2.24	2.17	1.70	.48	.21	.13	.33
C	2.11	.54	.94	.46	.27	.09	.14	.21
			Oil Analysis (By Vol.)					
C	.34	.43	.46	.45	.40	.64	.51	.38
C	.35	.34	.38	.39	.21	.20	.27	.13
C	1.24	1.27	1.30	1.24	.30	.26	.42	.06
C	.52	.57	.55	.45	.12	.06	.10	.22
C	1.51	1.55	1.35	1.04	.09	.09	.16	.08
C	2.42	1.02	.57	.31	.07	.05	.05	.03
R	93.62	94.82	95.39	96.12	98.81	98.70	98.49	99.10
			Partial Pressures in Oil					
C	7.07	6.93	7.30	7.81	4.21	3.78	5.28	2.50
C	5.11	5.18	5.08	4.85	1.14	.96	1.55	1.93
C	.70	.71	.67	.55	.15	.07	.11	.26
C	1.44	1.40	1.20	.89	.071	.08	.13	.07
C	.66	1.60	1.48	.083	.014	.010	.09	.006
			Partial Pressures in Gas					
C	50.03	52.07	51.48	51.96	56.30	60.32	62.48	59.74
C	5.89	6.15	6.07	6.57	5.63	3.39	2.02	3.43
C	5.14	5.33	5.35	5.24	2.04	1.41	.69	1.48
C	.87	.81	1.14	.71	1.04	.18	.05	.07
C	1.39	1.48	1.43	1.12	.31	.14	.09	.02
C	1.36	.36	.62	.30	.18	.06	.09	.01
			Saturation					
C	1.20	1.13	1.20	.84	.75	1.11	2.61	.73
C	.99	.97	.95	.93	.56	.68	2.27	1.30
C	.80	.88	.59	.77	.14	.39	2.20	3.71
C	1.03	.95	.84	.80	.23	.57	1.44	3.50
			Working Pressure					
	64.7	66.2	66.1	65.9	65.5	65.5	65.4	65.1
			Temperature					
	92°	89°	86°	84°	80°		78°	77.5°
			Total Oil Pressure					
	14.98	15.82	15.73	14.18	5.58	4.90	7.16	4.77
			Methane P. P. by Diff.					
	49.7	50.4	50.4	51.7	59.9	60.6	58.2	60.3

As to the cause of high absorption efficiencies, and how they may be attained, we were not able to discover anything definite. Butane efficiency was plotted against everything we could think of without results. The nearest to a definite relation was found between recovery and shell velocity, and this only for a definite absorber. Different oil and gas rates were run upon one absorber and the results plotted in Fig. 3. Keeping the shell velocity at 20. ft. per min. and varying the oil rate gave three points upon which the general curve is drawn. You will note that this conforms quite well with the curve in Fig. 1. If parallel curves are drawn through the four ft. and 24 ft. points they indicate a small but consistent increase in efficiency. The eight ft. and 17 ft. points are a little off. On one other absorber we have three tests, Nos. 11, 19 and 44. In fact No. 44 was run because we questioned the high efficiencies shown in Nos. 11 and 19. No. 44 was run very carefully and the results closely checked. It shows a still higher efficiency, 171%, and we could find no reason to question the result. These three points are also plotted upon Fig. 3 (marked with crosses) and show a general, though not regular, increase of efficiency with velocity. We tried marking in the velocities in a plot like Fig 1 and also plotting efficiency vs. velocity for all the tests, but wihout result. The effect of velocity was entirely masked by other and unknown factors, principally, no doubt, the intrinsic efficiency of the absorber.

ABSORBER TYPES

As to type of absorber, no difference is noted between perforated plates and bubble caps. One of each type is represented in the two highest tests, each 171%. Both types are also represented in the lowest efficiencies. Of the two highest efficiencies, in one case the gravity of the oil was 34.8° A.P.I. The lowest gravity reported was 34.3. In the other case it was 43°A. P. I., the highest gravity reported.

Assuming that the essential validity of the formula (Eq. 3) has been verified by the tests, but that the

effect of minor factors such as molecular weight and total absorption may be obscured by other factors, we tried a simplified formula. Taking Eq. 8 obtained by assuming that AG_a/m_a bears a constant relation to R_oG_o/m_o, and substituting the mean values, $m_o/G_o = 225.$ and ${}_nF'_4 = .84\,{}_nF_4$, we have

$${}_nF'_4 = \frac{.84 \times 3.55\ R_oP}{225\,{}_np_4} = \frac{.0133\ R_oP}{{}_np_4} \quad \ldots\ldots (9)$$

To verify this, ${}_nF'_4$ was plotted against R_oP as shown in Fig. 2, all questionable points were omitted which fell outside the dotted boundary lines. Among these were tests No. 34 and 44 which we felt belonged to a different class. These can be divided into two groups by another dotted line through the center. Collecting the tests according to this grouping they are tabulated separately in Tables IV and V. The mean temperatures are respectively 81.5° and 94.5°F. The corresponding pressures for normal butane are 38. and 47. pounds. Hence the coefficients for the two groups are

$$\frac{.764 \times 38}{2167} = 0.1340 \text{ and } \frac{.611 \times 47}{2240} = .01282$$

respectively. This checks very well with .0133 in Eq. 9 and fully justifies the inclusion of P_n in the formula. In general p_n may be obtained by assuming a 16°F. rise in the oil temperatures.

For average conditions ew believe the simplified formula is quite accurate enough to calculate the oil to gas ratio required to absorb all the normal butane the particular type of absorber is capable of recovering. The formula is,

$$R_o = \frac{75\,{}_np_4}{P} \quad \ldots\ldots (10)$$

Expressed as a working rule it would be; calculate or estimate the temperature of the oil leaving the absorber. Take the vapor pressure of normal butane at this temperature, multiply it by 75 and divide by the working pressure (absolute) in the same units.

MOMENCLATURE

A — Total absorption in gals. per 1000 cu. ft. Wet Gas.

A_c — Total absorption in cu. ft. per 1000 cu. ft. Wet Gas.

C — Coefficients.

C_1, C_2, C_3, ${}_iC_4$, ${}_nC_4$, $C_{5\,plus}$—Methane, ethane, propane, isobutane, normal butane and pentane and heavier, called "pentane plus." Same subscripts are used throughout to identify components. In general C_n.

D — Total dry gas in cu. ft.

D_1, D_2, D_3, etc—Percent of component in dry gas.

E_3, ${}_iE_4$, ${}_nE_4$, E_{5plus}—Absorber efficiencies in recovering propane, etc.

F_3, ${}_iF_4$, ${}_nF_4$, $F_{5\,plus}$—Calculated recovery fraction for propane, etc.

F'_3, ${}_iF'_4$—$F'_{5\,plus}$—Actual recovery fractions.

G_a, G_o—Specific graivities for gasoline absorbed and absorbent oil.

L — Pound mols of total liquid.

L_1, L_2, L_3, etc.—Pound mols of component in liquid.

P — Working pressure in lbs. per sq. in. (abs).

P_1, P_2, P_3, etc—Vapor pressure of pure components.

R_o — Oil to gas ratio in gasl. per thousand standard cu. ft. of wet gas.

V — Pound-mols of total gas.

V_1, V_2, V_3,—V_n—Pound-mols of components in gas.

W — Total wet gas—cu. ft.

W_1, W_2, W_3, etc.—Percent of components in wet gas.

x_1, X_2 X_3,—Xn—Mol fractions in liquid.

y_1, y_2, y_3—yn—Mol fractions in gas.

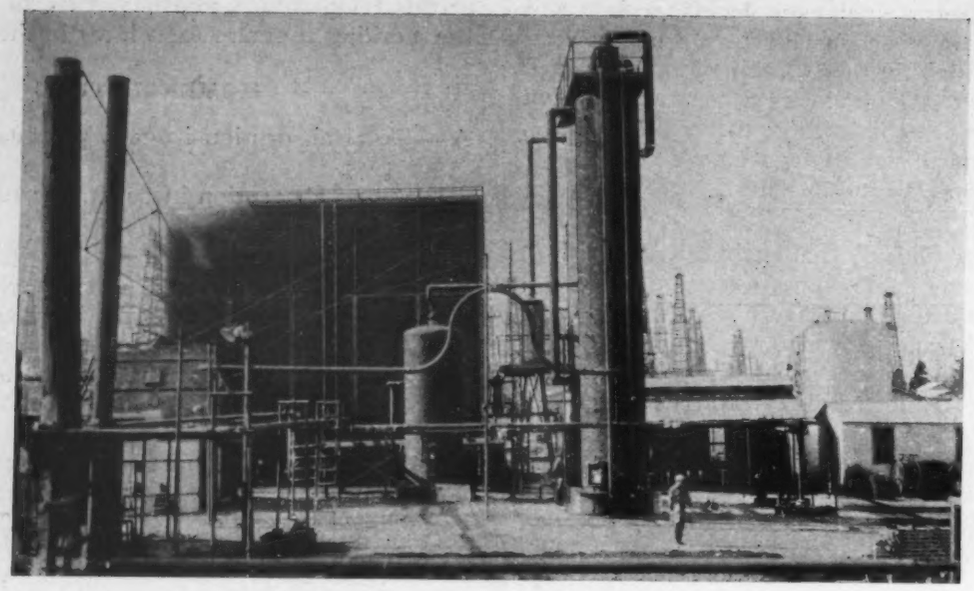
(taken equivalents to volume fractions.)

Small Plant Has High Throughput

By GEORGE REID
Associate Editor

THE 3000-barrel skimming plant of the Eddington Witz Refining Company, at Signal Hill, Long Beach, California, is an example of the modern trend of refinery toward relatively large daily capacity with the compact multiple-flash distillation and fractionation system. Plants of this type have the additional advantage over the older designs of occupying but little ground space; and they can be operated on small sites. Further, they have a high salvage value. Where the 3000 barrel plant of some few years back required large shell stills, condenser boxes, and other equipment, the modern installation of the same and larger capacities might well be classed as portable. The Eddington-Witz plant at Long Beach, in so far as distillation, heat exchange, condenser and fractionation equipment is concerned, together with pumping equipment, power house and treating plants, occupies a site no larger than that of a nearby small natural gasoline plant. Further, its crude oil and finished products storage tankage is reduced to the minimum and congestion is easily avoided by constant efficient transfer and dispensing of products.

In this type of multiple-flash system but two bubble type fractionating columns are employed to separate the crude into four major products of gasoline, kerosene, stove distillate and fuel oil. The columns are divided into compartments with reboiler sections in which superheated steam is employed incorporated in both towers. While two tube stills are shown in the accompanying illustration, only one is used in plant operation. Signal Hill deep sand crude oil is distilled. This production has an average gravity of 26 A. P. I. and an average gasoline content of 26 per cent. The plant was installed for the company by the South-



Two fractionating columns are used in this multiple-flash system. Gasoline vapors from the evaporator are conducted to the first bubble tower

western Engineering Company and was placed in operation in March, 1928.

Crude entering the plant passes through the Gardner charging pump to the heat exchanger. Sufficient cool crude oil is by-passed from the main circuit through smaller lines up to the temperature control section mounted at the top of the first bubble tower. The volume of oil required for this temperature control is regulated by a Tycos recording temperature controller. After passing through the "knock-out" section, the oil returns to the cool oil circuit and is taken into the heat exchangers. After passing through the tubular exchange section, the oil passes into the long pipe series of exchangers. The inside pipes pass outward from the exchanger proper through packed glands and are looped, four of them horizontally and two of them vertically, to take care of all expansion and contraction of the metal tubing. In passing through this exchange equipment the incoming oil is preheated to 250 degrees.

BLENDED IN VAPOR STATE

At this temperature about 10 per cent. of the gasoline is vaporized. The advantages of removing as much as possible of the lighter portions of the gasoline from the crude are recognized, and not only does such practice reduce the work of the still, and thus tend to increase its capacity, but the portion of the crude so vaporized in the exchanger equipment is not unnecessarily subjected to the higher temperatures prevailing in the retort tubes.

After being preheated, the crude flows into an evaporator where all of the liberated vapors pass overhead through a vapor line into the side of the first bubble tower at about two-thirds of its height. Here they mix with vapors leaving the oil after it has been subjected to the temperature of the pipe still. By blending back in this manner in the vapor state, instead of condensing this light fraction direct from the evaporator there is no evaporation loss incurred by this fraction, and cold blending of the two finished fractions is eliminated. Also, if any heavier particles are entrained with the light vapors, they are fractionated into the proper cut as the vapors flow through the two rectifying columns.

Crude oil accumulating in the bottom of the evaporator drum is picked up by a Worthington Simplex pump, 14 x 8 x 12, and discharged to the pipe still. The rate of pumping is regulated by Fisher controls regulating pumping rate by remote control. In passing through the tube still the crude is heated to 525 degrees.

The tube still is composed of three- and four-inch tubes, and fired by gas. A Lientz hot air recirculating system supplies preheated air to the furnace. A recent test run of this still operation indicated a natural gas consumption of 170,000 cubic feet while operating at 3000 barrels of oil per day. Warm air to the still furnace was reported at 260 degrees and the writer was informed that the average stack temperature was 170 to 175 degrees. Based on the approximate cost of industrial gas in the area, which averages around 6 cents per thousand, this still is operating at a fuel cost of approximately 1 cent per barrel of oil handled.

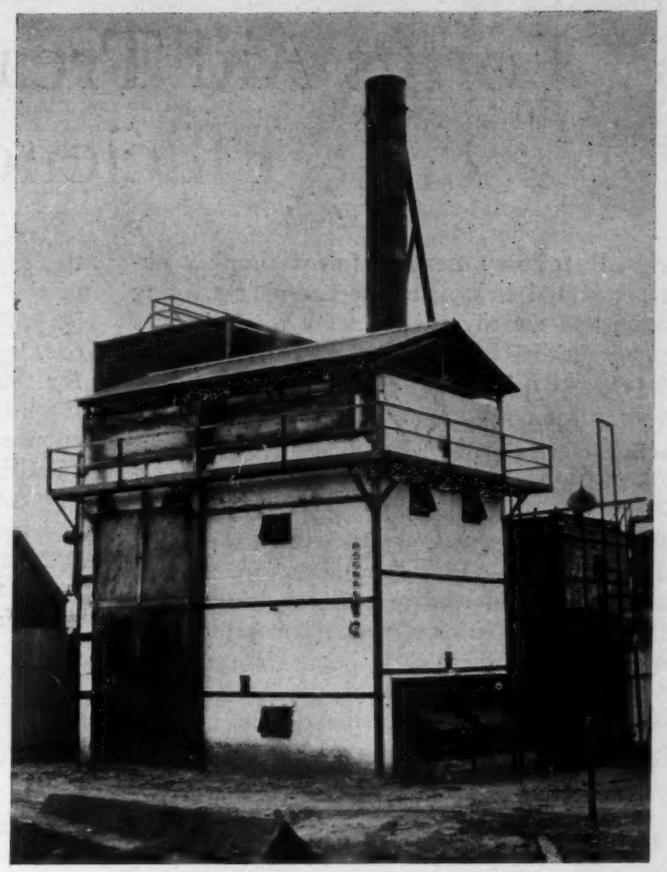
Heated crude passes into the bottom section of No. 1 tower, releasing the vapors to flow upward through the tower. Residuum is removed from the bottom of this lower compartment by a hot oil pump which is regulated by remote control by a Fisher liquid level regulator. This oil passes into the exchangers at a temperature of around 480 degrees, and leaves the exchangers at 135 degrees.

STEAM FROM TUBE STILL

Vapors rising from the separator section of the first column are fractionated through a series of bubble trays. Just above the separator section is a reboiler compartment in which the reflux accumulating as it descends from the upper trays is flashed with superheated steam. The superheated steam is derived from the tube still, where it is superheated to about 600 degrees in a transverse coil near the top of the furnace. The reflux as it accumulates and is flashed in the reboiler section is withdrawn from the tower as a side stream of stove distillate. The remaining kerosene and gasoline vapors pass out of the first tower through the control or "knock-out" section, and downward to the bottom section of the second fractionating column.

This tower likewise consists of two sections. In the bottom or reboiler compartment the accumulating re-

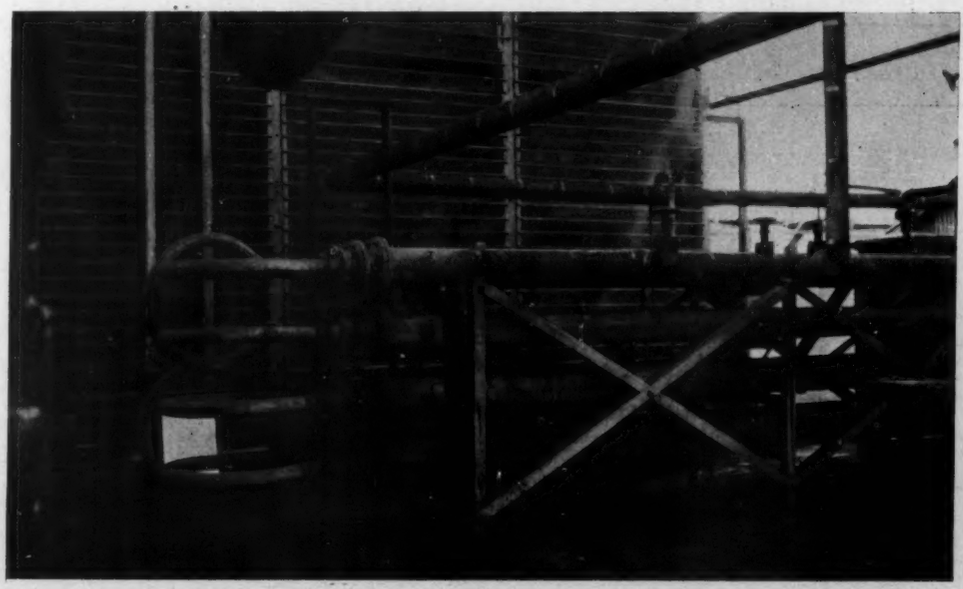
flux material from the uppermost trays is flashed with sufficient superheated steam to drive off all lighter or gasoline vapors and leave kerosene to be withdrawn as a bottom stream from the tower. Gasoline vapors are removed overhead through a primary cooler of Southwestern type, and a final cooling coil in the nearby cooling coil. Fractionation is efficient in towers of this design and it is possible to produce a negative gap of 34 degrees between the end point of the gasoline and the initial boiling point of the kerosene. Kerosene specifications, however, which must be met, so influence plant operations that a negative gap of only five degrees was produced at the time of the writer's visit. Tycos recording temperature control instruments are employed to regulate both the end point of the kerosene and gasoline fractions.



Three thousand barrel pipe still with three and four-inch tubes, equipped with hot air reciprocating system, at Eddington-Witz Refining Company's Long Beach, California, plant

The power plant consists of two Collins water tube boilers of 80 horsepower rating and two horizontal return tubular boilers which are being replaced by additional boilers of the Collins type. The boiler installation is automatic in operation through the use of Wilgus regulators on the gas line and James feed water regulators. The boilers are fired through National gas burners. Through the use of modern automatic control devices at the power plant and at the refining equipment, labor overhead is reduced to the minimum. But two men on each shift are required to operate the refinery, not including the superintendent and chemist.

Gasoline is treated continuously, using but three-tenths of a pound of acid per barrel, which is followed by neutralization in the first of a series of two small contact clay filters, with "neutracel" clay. A second mixing and filtration with ordinary contact clay for brightening, completes the treatment. Each of the clays are used in the proportion of about two-tenths of a pound per barrel of gasoline. The treating plant will be the subject of a future discussion. At present the experimental installation is handling about 85 barrels per hour. A larger unit is being installed. Based on the above acid and clay requirements it is obvious that chemical treating costs by this method are very low.



Close-up of exchanger equipment. Expansion and contraction is taken care of by means of packed glands and looped piping

Forms Aid Treating Plant Efficiency

SUITABLE refinery treating forms simplify obtaining essential information concerning treating operation and thereby show readily what changes should be made in the chemical treatment of oils in order to obtain greater efficiency.

Primarily for suggesting how improvements may be made in refinery treating forms, the writer will mention several forms being used in refineries in various sections of the country. This may be of assistance to the refinery executive, suggestive as to changes that may be applicable to his own particular plant's forms. It is not necessarily to be inferred that the treating forms shown are the best forms for all cases; but rather that such forms shall be construed as being indicative of how some refineries have met certain particular problems in securing necessary information on the treating operation.

BATCH AGITATION RECORDS

Figure 1 shows the treating report used by one refinery in keeping a record of essential information required in connection with treating light oils. Although this report was drawn up primarily for keeping a record of the treatment of oils in batch agitators, it has also been used when such light oils are treated in a continuous, light-oil treating system, though it is less adapted for the latter use. On this report, provision is made for keeping (1) a record of the agitator in which the oil was treated; (2) the "batch number" of the batch of oil being treated; (3) the kind of oil being treated; (4) outage of the agitator, that is, the number of feet and inches from the top of the agitator to which the agitator was filled, and hence, from this information, the exact number of barrels that were placed in the agitator; (5) the tank from which the agitator was filled; (6) the kind and exact amount of chemicals used in treating that particular batch of oil; (7) the amount of oil in the agitator after treatment, as a result of which it is possible to ascertain how much oil was lost in the treating process; (8) the tank to which the treated oil was pumped; and finally (9), the color and "doctor test" on the treated oil. On this form provision is also made for any further incidental remarks of the "treater," as well as allowing space for his signature.

PRODUCERS & REFINERS CORPORATION

TREATING REPORT Parco, Wyo. ____ 192__

Agitator No. _____ Batch No. _____

Oil Treated	Outage Ft.	Outage In.	Barrels	From Tank

Chemicals Used

Sulphuric Acid _____ Pounds

Doctor Solution, Grav. _____ Gallons

Caustic Soda Grav. _____ Gallons

Sulphur _____ Pounds

After Treating

Outage Ft.	Outage In.	Barrels	Into Tank	Color	Doctor

Remarks

_____

_____

_____

_____

Treater _____

FIGURE 1

LIGHT OIL RECORDS

Whereas Figure 1 showed the treating form that one refiner uses for keeping a record of necessary data in connection with the treating of light oils, Figure 2 shows a form that is equally applicable to the keeping of necessary information obtained in treating either light or heavy oils; and hence the second form can be used by refiners who are manufacturing lubricating oils as well as gasoline, kerosene, naphtha and other light products.

By the use of a form such as is indicated by Figure 2, the refinery executive obtains information concerning the following points:

1. Specifications of oil treated.
   - Kind of oil.
   - Gravity.
   - Flash.
   - Cold test.
   - Color.
   - Viscosity.
   - Initial boiling point.
   - End point.
   - Temperature of oil.
2. Amount of oil in agitator after each treatment, and temperature of said oil when the outage gauge was obtained.
3. Per cent. of loss.
4. Tank number from which the agitator was filled; gravity of the oil in that tank and first and final gauges on that tank, both before and after the agitator was charged, from which gauges are calculated the number of barrels of oil pumped from the tank.
5. Similar information as indicated in "4" concern-

PLANT _____ MANUFACTURING DEPT _____ DATE _____
AGITATOR No. _____
AGITATOR REPORT

SPECIFICATIONS OF OIL TREATED

KIND OF OIL _____
GR. _____ FLASH _____ CT _____ E.P _____
COLOR _____ VIS. _____ I.P. _____ TEMP _____
WATER DRAWN FROM _____ TO _____

CHG FROM TANK No	GRAV	1ST GAUGE FT	1ST GAUGE IN	FINAL GAUGE FT	FINAL GAUGE IN	BBL AT 60° F

OUTAGE

	FT	IN	BBL	TEM	BBL@60
FIRST					
SECOND					

% LOSS AT 60°F

DELIVERED TO TANK No	GRAV	1ST GAUGE FT	1ST GAUGE IN	FINAL GAUGE FT	FINAL GAUGE IN	BBL AT 60° F

TIME STARTED PUMPING TO AGT _____ TIME FINISH PUMP OUT _____ TOTAL ___ HRS. ___ MIN.
TIME STARTED TREATING _____ TIME FINISH TREATING _____ TOTAL ___ HRS ___ MIN.

		GRAV	TANK No	1ST GAUGE FT	1ST GAUGE IN	FINAL GAUGE FT	FINAL GAUGE IN	GAL	LBS	TEM	BLOWN HRS	BLOWN MIN	SETTLED HRS	SETTLED MIN
SULPHURIC ACID	1ST TREAT													
	2ND TREAT													
	3RD TREAT													
RESTORED ACID	1ST TREAT													
	2ND TREAT													
	3RD TREAT													
SLUDGE ACID	1ST TREAT													
	2ND TREAT													
	3RD TREAT													
CAUSTIC SODA														
OLD CAUSTIC														
WATER WASHING														

SUMMARY OF CHEMICALS USED

CHEMICAL	GR	LBS	LBS PER BBL	CHEMICAL	GR	LBS	LB PER BBL
NEW ACID				SLUDGE ACID			
REST ACID				OLD CAUSTIC			
NEW CAUSTIC				SODA ASH			
LITHARGE				AMMONIA			
SULPHUR							

TESTS ON TREATED BATCH

GRAV _____ I.P. _____
COLOR _____ E.P. _____
FLASH _____ TEMP. _____
VIS. _____ ASH _____
C.T. _____

REMARKS

_____ TREATER

FIGURE 2

ing the tank to which the treated oil was pumped from the agitator.

6. Time at which charging the agitator was started; time at which the agitator was pumped out; and hence, the total number of hours and minutes required for the treating of that particular batch of oil, including charging and pumping-out time.

Time at which the first chemical was applied to the oil; time at which the chemical treatment of the oil was completed; and hence the time required, in hours and minutes, for the actual chemical treatment of the oil.

7. Detailed information concerning the kind and amount of sulphuric acid of different strengths used in treating the oil.

8. The time that the oil was blown with acid at each treatment, and the number of hours and minutes that it was allowed to settle after the application of the acid.

9. Detailed information concerning the strength and the amount of caustic soda or of soda ash used in treating the oil, as well as the number of water washings given after the lye treatment.

10. A summary of the kind and the amount of chemicals used, such as new or re-stored sulphuric acid or sludge acid, the gravity of each, and the number of pounds of each used per barrel of oil treated; or, if used, strength and amount of new or old caustic soda or soda ash; also data on any ammonia, litharge or sulphur used.

11. Physical tests on the treated oil: if a lubricating oil, then the flash, color, viscosity, cold test, per cent. of ash, and temperature of that oil; if a light oil, then the gravity, color, flash (on kerosene, heavy naphthas and burning oils), initial boiling point, final boiling point and agitator temperature of such oils.

In other words, the above form (Fig. 2) is such that it is applicable for use in keeping a record of the treatment of any lubricating or light oil by any of the more common methods of chemical treatment.

AGITATOR SUMMARY

Figure 3, "Agitator Summary," shows a form that one refiner has used successfully in keeping a monthly record of all of the different kinds of oil that were treated in the batch agitators of his refinery. On this form, information is given (1) as to the date on which the particular batch of oil was treated, (2) the agitator in which it was treated, and (3) the particular batch number; also (4) the amount of oil charged to the agitator, (5) the yield of treated oil, and hence, (6) information as to the number of barrels of oil and (7) the per cent. of loss from the chemical treatment; (8) detailed information concerning the quantities of chemicals used; and (9) full data as to the physical tests of the oil, both before and after chemical treatment.

Figure 3 is a monthly summary of the information given in the form indicated by Figure 2, which form, it was noted, provides for detailed information concerning each particular batch of oil as treated each day.

Figure 4 shows a *"Sludge Acid Separator Report"* that one refiner has used to advantage in keeping a record of his sludge acid separators.

Many refiners engaged in the manufacture of lubricating oils find it economical to operate "separators" and "acid-recovery systems," as a result of which a large percentage of weak sulphuric acid is recovered from the sludge, which acid is re-concentrated in the acid-recovery plant and later used in treating new batches of lubricating oil. By neutralizing the separated sludge with lye solution and thereafter "fluxing" this sludge with fuel oil, or, preferably with a mixture of fuel oil and neutralized sludge from the treatment of light oils, a product is obtained that is burned successfully under boilers or stills. This method of "sludge-disposal" is not only advantageous in that it permits utilization of the heating value of the sludge, but, in many cases, it is the only method that can be used and becomes necessary when there are in effect local or state ordinances or laws against pollution of streams and the refiner can not dispose of his sludge without such contamination of waterways taking place.

The "Sludge Acid Separator Report" represented by Figure 4 therefore should be of interest to those refin-

PLANT _____ MANUFACTURING DEPT _____ FROM _____ TO _____
CHARGE
AGITATOR SUMMARY

DATE	No AGITATOR	CHG BBL	YIELD BBL	LOSS BBL	CHEMICALS								TESTS BEFORE TREATING								TESTS AFTER TREATING							

ers operating acid-recovery systems, since sludge-acid separation and acid concentration of the recovered acid are two closely allied operations.

This report gives the following information to the refinery executive in condensed form:

1. The number of the particular separator being used and referred to in the report.
2. The "batch number" of the particular batch of sludge being processed through the separator.
3. The number of the treating agitator from which the sludge was drawn.
4. The time at which drawing of the sludge started or, if desired, the total time required for withdrawing the sludge from the agitator.
5. The amount of sludge drawn off.
6. Data on the separating operation, including gravity, temperature, gauge readings (and hence, barrels) on the product in the separators both before and after all the weak acid has been drawn off; also, loss in barrels as a result of the separation.
7. Data on the recovered acid, including (1) number of the tank to which the recovered acid was pumped; (2) gravity of that recovered acid; (3) gauge readings on the acid tank both before and after the pumping was made; and hence (4) the number of pounds of weak acid pumped to the tank.
8. Data on the materials used in accomplishing the separation of the weak acid from the sludge, including (1) the gravity on the caustic soda solution and the fuel oil used; (2) the gauge readings on the lye solution and fuel oil tanks both before and after making any transfers to the separator; and hence (3) from the gauge readings, the amount of caustic soda solution and of fuel oil used in the operation.
9. Data on the weak acid separated from the sludge and sent to the acid-recovery plant for concentration, including (1) the number of the tank from which the separated acid was pumped; (2) the gravity of that acid; (3) the gauge readings on said acid tank both before and after a transfer was made; and (4) from these gauges the amount of acid in pounds is ascertained and recorded.

PLANT _____ MANUFACTURING DEPT _____ Date _____ 192_

SLUDGE ACID SEPARATOR REPORT

Separator No.	From Agt	TIME	From Agt.	TIME	Sludge Off
Batch No.					

SEPARATOR GAUGES

Before Settling					After Settling					LOSS BBLS
Gravity	Temp	Gauge Ft	Gauge In	BBLS	Gravity	Temp	Outage Ft	Outage In	BBLS	

Acid Recovery							Materials Used						
Ch to Tank No.	Gravity	Gauges First Ft	First In	Second Ft	Second In	POUNDS	MATERIAL	Gravity	Gauges First Ft.	First In	Second Ft	Second In	AMOUNT
							Caustic						
							Fuel Oil						

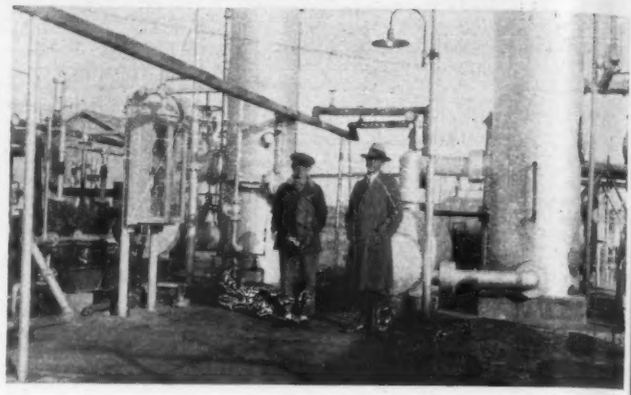
SEPARATED ACID TO ACID PLANT

From tank or Agt No.	Gravity	Gauges First Ft	First In	Second Ft	Second In	POUNDS	REMARKS

FIGURE 4 ---------- OPERATOR

Dealing in Personalities

By GEORGE REID



W. L. Isaacs and H. R. Campbell

WHERE SKELLY MAKES SKELGAS

SKELLY OIL COMPANY manufactures "Skelgas" at its Lyman, Oklahoma, oil absorption natural gasoline plant, where its high pressure fractionating system, installed for the preparation of liquefied lighter fractions, has been in service for the past year or more. In the accompanying picture Plant Superintendent H. R. Campbell, and Chief Chemist W. L. Isaacs are standing at the base of the two fractionating columns comprising the "Skelgas" plant.

The plant operates independent of the oil absorption natural gasoline plant. The equipment is sufficiently flexible that three grades of gasoline may be produced. Grade AA may be withdrawn from the bottom of the first tower, Grade BB from the second column, and "Skelgas" removed from the top of the second tower, for example. Gasoline which is butane-free may be produced, along with practically pure butane and "Skelgas." Practically any grade of gasoline may be made without interfering with production of "Skelgas."

At the Lyman plant, the high pressure fractionation, or "Skelgas," plant is located in the center of the natural gasoline plant equipment so that no additional labor is required for the operation of the high pressure installation.

All pumps, control instruments and instrument board are located centrally for the convenience of the operator.

Superintendent Campbell and Chief Chemist Isaacs appear warmly clothed, which was necessary when this photograph was taken late in January.

ABOUT GEORGES

AT San Angelo, Texas, George Buckner and S. E. Davis, the gentlemen in the picture, hold forth at the plant of the San Angelo Refining Company, where they cajole their equipment, or use force if necessary, into securing higher gasoline yields from the barrel of crude. Buckner, with the cigar, is manager

and secretary of the company. Davis, with the improvised arm rest, is plant superintendent.

George Buckner is a nephew of Dr. George Buckner, Bakersfield, California. Uncle and nephew have never met. Georgie Reid, in this case the third George, or George III, of THE REFINER, visiting San Angelo, noticed the likeness of nephew George of Texas to Uncle George of California. (Uncle George is associated with a fourth George, one George Reid, Senior, in a small California oil company). Reid, Jr., carried felicitations to California from nephew to uncle, which is as near a meeting as the two have ever experienced. This world is not so big.

Years ago S. E. Davis operated the treating plant at the old American Refining Company, Wichita Falls, while George Reid was chief chemist for the same company, and while six cracking units were performing miracles in producing gasoline that did not like the sunshine. Together the two fought their battle out, separated and lost contact, to renew friendship when Reid of THE REFINER dropped in on the San Angelo plant. The world is only so big.

The San Angelo Refining Company, of which W. B. Hassett is president, has a rated capacity of 1500 barrels. It is equipped with bubble towers designed by Clive M. Alexander. Other affiliated companies are Wickett Refining Company and Bluebonnett Oil Refining Company, both plants at Wickett, Texas, and Imperial Refining Company and Kettle Creek Refining Company, with plants at Ardmore, Oklahoma, and El Dorado, Arkansas.

CAMPBELL TESTING RESULTS

J. A. CAMPBELL, Long Beach, California, caught in the act of checking the gravity of production of State Gasoline Company's No. 3 plant at Signal Hill. J. A. is standing at the base of the first installation of his new stabilizing tower or fractionator.

This stabilizer, for which application for patent has been made, incorporates some changes in design. It is divided into three parts, each having a separate function. The bottom section, consisting of four plates is the stripping section; the next six plates are in the production wash section, and the upper eight plates are in the reflux wash section.

Each of the four plates in the stripping or lower section has a steam heating coil where the gasoline in that section is heated. It overflows into a perforated pan,

George Buckner and S. E. Davis

J. A. Campbell

is broken up into about 2000 streams, and splashes into the next coil-filled pan below. The steam coils in each pan are fed by a main steam header, and each coil is provided with a valve controlling steam injection, and all coils discharge into one header line. Through manipulation of these inlet valves on each coil a uniform temperature gradient is established and maintained across the coils. Thermometers are provided for checking temperature.

It is said that through the means of the multiple-stage or gradual and successive heating, a minimum of heavier fractions is liberated to pass upward into the tower, and this tends to reduce the work imposed upon the equipment. Gasoline vapors pass upward from the heating section through the production wash compartment and then on upward through the reflux wash section and into the reflux condenser.

DEFLOREZ STILLS

In addition to the two deFlorez Vapor Phase cracking plants started building recently and since the announcement of the perfection of the process at Gulf Refining Company's New Jersey refinery, there have been 43 deFlorez circular tube stills placed under construction.

These tube stills are building for service in cracking, topping and vacuum distillation.

In speaking of this still in a recent letter deFlorez says that the vertical still makes it possible to burn fuel with high CO_2 and to make use of virtually all of the heating surface. One still in operation with a cracking unit has an average transfer rate over the whole surface in excess of 10,000 B.T.U. per square foot per hour. When such results are compared with the usual average it is surprising that the surface can do so much work without burning the tubes or carbonizing. It also relieves the pumping pressures since one-third to one-half of the length of tubing can be made to do the work of the usual requirements.

PETTY AND RIDGWAY IN THE MID-CONTINENT

Earl Petty and C. M. Ridgway of the engineering firm of Smith & Leslie, Inc., Oil City, Pennsylvania, and Kansas City, Missouri, moved to Tulsa, where they are visiting refiners as the sales engineers for their company. Petty and Ridgway have temporary headquarters at 1622 South Boston Avenue.

Earl Petty will be remembered as operating manager for the McKean County Refining Company, Bradford, Pennsylvania. Petty laid out this plant in the early fall of 1926, and left for Argentina to put in a lube plant for the Argentine government, sailing from New York in October on the Vestris, which sank off the coast of Virginia. Captain William Carey, master of the Vestris, signed Petty's "Neptune Court" certificate. After a trip to Patagonia, Petty returned to New York in February, 1927, going then to manage the Pennsylvania refinery mentioned, from which connection he came to join the Smith & Leslie organization.

C. M. Ridgway was formerly with the E. B. Badger & Sons Company of Boston. He is a graduate of the University of Michigan where he studied under Dr. Leslie. C. M. is a grandson of "Uncle Sam" Ridgway, well known to old timers in Oildom, as a doctor, farmer, and early oil man, of Hydetown, Pennsylvania. At Hydetown, Doctor "Uncle Sam" used to rub away the rheumatics of the early day oil man with a potent mixture of "light naphtha" and oil of wintergreen. J. R. Barrott, refinery superintendent at Transcontinental Oil Company's Boynton, Oklahoma, plant says that "Doc." Ridgway used to "perform on his father," but he believes that success of the treatment was due to the size of "Uncle Sam's" hands and his ability to massage, rather than to the efficacy of the liniment.

INDIAN'S FIRST AND LAST CROSS UNIT

On the site of the first commercial Cross cracking unit ever built there stands the latest one. The first one went on stream very early in 1920. The last one went on stream in late August, 1928. There is a world of difference between the "Daddy" of Cross units, and the sturdy youngster now operating in the "Daddy's" footprints. The new unit was especially designed by Cross and Indian Refining Company's engineers to operate with recycle stock from other Cross units as charging stock. Operating with much higher velocity of oil through smaller tubes, at somewhat higher temperatures and pressures the new unit yields 33 per cent. and better of gasoline cracked from recycle stock. Construction and operation details were presented in the November issue of this magazine. Col. J. H. Graham, president of the Indian Refining Company, states that the company will soon begin erection of another large Cross unit, which will give this company a battery of 13 "crackers," and that "while we are not afraid of the 'jinx' number, we will likely make further additions to the cracking department."

MORE CHEMICAL ENGINEERS DEMANDED

Petroleum refining is increasing its demand upon the colleges and universities for chemical engineers as it moves more definitely toward a scientific basis. The refining industry is attracting and absorbing twice as many graduate chemical engineers as is any other industry.

A survey conducted by Chemical & Metallurgical Engineering and discussed by James A. Lee, assistant editor, in the July issue, page 415, indicates that one chemical engineering graduate in every six is attracted to the petroleum refining industry. The current year college crop of chemical engineers totaled 741 from 55 institutions reported, of which group about 125 men entered the petroleum refining field. The number was not greatly less in 1928 or 1927. This is not the total figure, since there are about 80 institutions in this country giving courses in chemical engineering. It is thought, however, that the percentage of graduates attracted to the 19 industries utilizing such special training will hold true for all graduates.

Every indication points to the fact that petroleum will continue its trend toward a strictly scientific industry, or chemical engineering industry, in the future. It is demanding more graduates of this type than the training instiutions can supply. In addition it is requiring more chemists and physicists than ever before.

In 55 colleges and universities in this country Chemical and Metallurgical reports a total of 4541 registered chemical engineers in training. The 80 institutions would show a much greater number if the data were available. In all probability at least one-sixth of the graduates will enter the petroleum industry, for penetration of chemical engineering in this field is not near to the saturation point.

Such factors as liquid and vapor phase cracking, hydrogenation, manufacture of paints, soaps, special lubricants, greases, and an ever extending category of special industrial products contribute to the need of the chemist and chemical engineer in the refining industry.

OIL EXPOSITION IN LOS ANGELES

An Oil Equipment and Engineering Exposition will be held in the Shrine Auditorium at Los Angeles, California, March 16-23, inclusive, 1930.

Scientific exhibits by universities and governmental agencies will be given free exhibit space. Headquarters for the Exposition are being maintained in the Petroleum Securities Building, Los Angeles.

Demand For White Oils Introduces New Manufacturing Methods

NOT until recently have white oils become well known, and the demand seems to exceed the supply. The great majority of vegetable and animal oils on the market today possess a decided characteristic color as well as taste and odor. The latter two aid markedly in identification. The former, which is natural, is not destroyed in the extraction or refinement to a finished commercial product. In many cases where the refining of vegetable oils is concerned, the nature and qualities of the oil have been destroyed simply because the color specification was the controlling factor of the finished product. The demand for a colorless, odorless and tasteless oil automatically diverted the attention of the refiner from animal and vegetable oils to that of mineral oils. It was not long before the refiner discovered that this class of oils could be given much harder treatment both physically and chemically without destroying the characteristics for which it was refined. On account of the nature of petroleum distillates it was discovered that a very undesirable characteristic, odor, could be readily removed by certain methods of refining and chemical treatment. At first the methods were rather unsuccessful, but after considerable research and plant technology remarkable results were obtained both in distillation and treatment.

White oils possessing stable qualifications are by no means easy to make. By stable qualifications is meant stable to light and heat. Odor is a vital specification also and unless an oil remains absolutely odorless for an indefinite length of time it may not be classified as a good oil. Of all the different grades of oil made, white oils, in their manufacture, receive the most stringent treatment of any. In preparing the distillates for white oils many important points must be considered, among which are polymerization, oxidation, and break down. It is very important, therefore, from the start to select the best grade or grades of oils that will yield the most desirable distillates. On first consideration it would appear that pure paraffine base crudes should yield the best distillates, those whose tendency to polymerize and oxidize are very slight. As a matter of fact, it was found that excellent distillates could be obtained from pure asphaltic base crudes. It was interesting to note the results obtained in each case and the comparisons between them.

It is of great importance to select the best grades of crudes in order that the distillates might be of the best quality. In selecting a pure paraffine base oil Morgantown crude is suggested. This crude has a gravity of 43.5°, possesses a greenish red color, yields only a trace of B. S. at 70°F. and 100°F., has a viscosity of 39 at 100°F. Saybolt, shows only a trace of sulphur, yields 56.0 per cent. over at 608°F. by assay distillation. Another crude which was used in this work was Eureka crude. Both these oils are pure paraffine base, produced from Pennsylvania wells. Eureka crude has the following properties; color—dark green; gravity 43.3°; B. S. at 70°F.—trace; at 100°F.—trace; Viscosity at 100°F. Saybolt—41; Sulphur—nil; assay distillation at 608°F.—62.0 per cent. Both of these oils yielded excellent distillate stocks for the manufacture of white oils.

A pure asphaltic base crude, namely, West Columbia, possesses the following properties: Gravity—21.4°Be.; Color—greenish-brown; B. S. at 70°F. 2 per cent. B. S. at 100°F.—1 per cent; Saybolt viscosity at 100°F.—156; Sulphur—.26 per cent; Pour—0; assay distillation over at 608°F.—39.0 per cent. Although this crude contains considerably more sulphur than the paraffine base crudes, it is removed in its refining so that the finished product is void of this undesirable element. There are various other crudes which may be used advantageously for yielding good white oil distillate stocks but the above suffice.

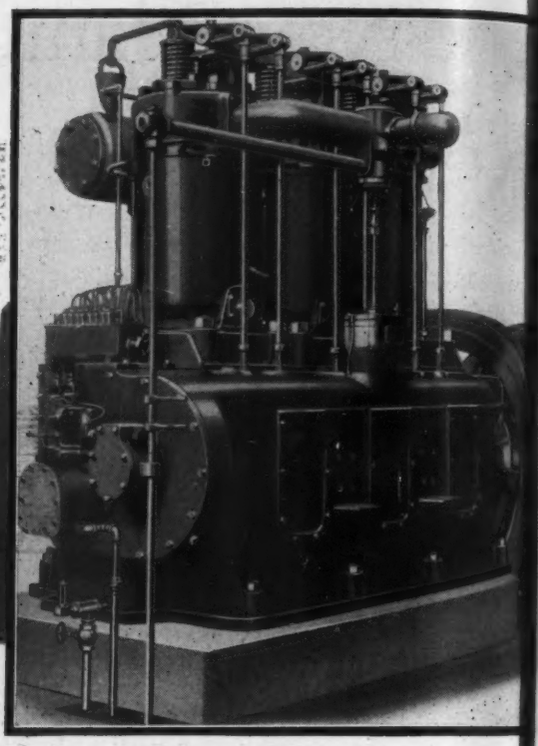
METHOD OF DISTILLATION

The crude oil is charged to a standard horizontal shell still to the desired outage and then fired in the usual manner. The operation is that carried out in running any standard batch still. The first cut over head is made from over to 60 Be. and represents a light naphtha cut. The second cut is made from 60° Be. to 52.5°Be. and represents approximately 11 per cent. The third cut represents a 150 water white cut from 52.5° to 41.5°Be. giving a yield of 25.8 per cent. This cut will have a gravity of 46.2°Be. Cut four is represented by the over head fraction between 41.5° and 39°Be. The yield of this cut is 6.5 per cent. It has a gravity of 40°Be., a flash of 255° and a fire of 395°F. Cut five and the one in which we are particularly interested for the white oil stock is made between 39° and 33°Be. This fraction represents 14.0 per cent. of the crude oil charged. It shows the following tests: Gravity—36°Be, Cloud—70°F. The last test indicates the presence of considerable wax and such was found to be the case. It might be stated also that the wax was crystalline in nature. Before acid treatment of the white oil stock can be made it is necessary to remove the wax.

REMOVAL OF WAX FROM DISTILLATE

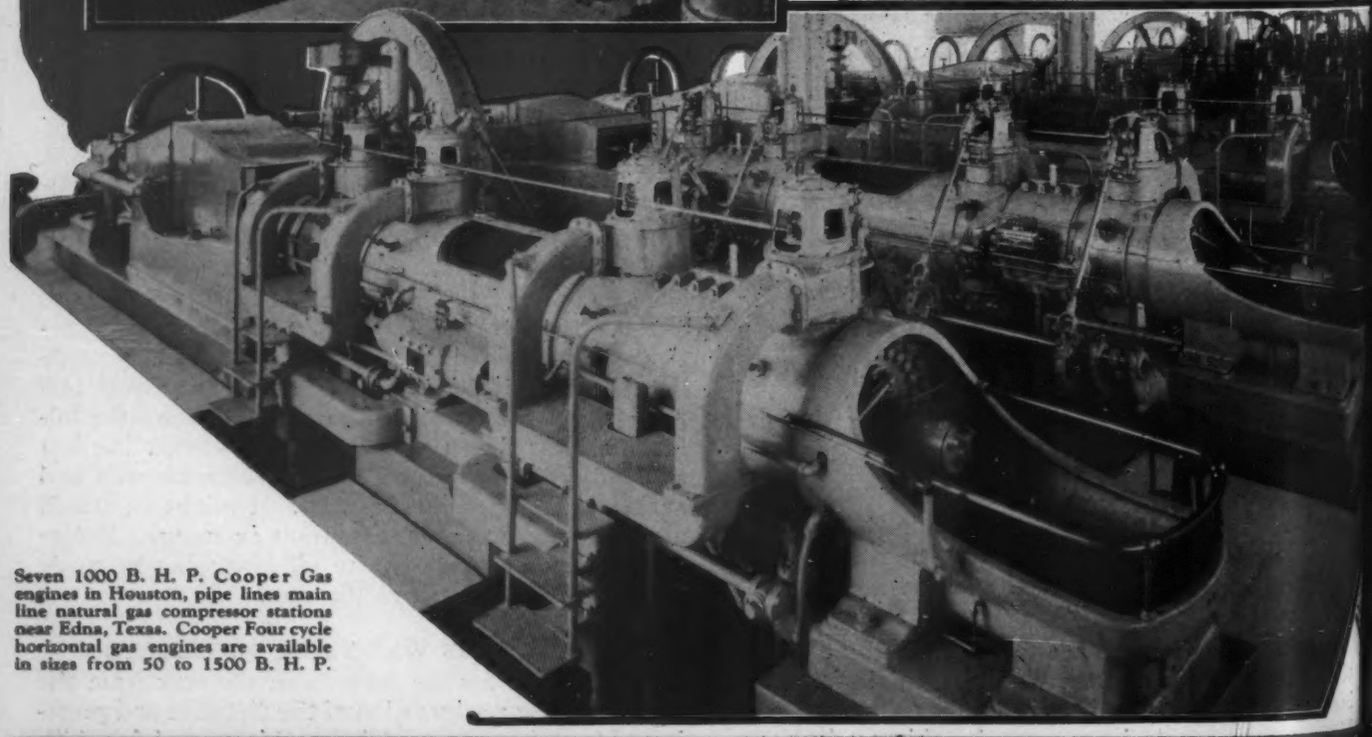
The method for the removal of the wax from the distillate is by refrigeration of the distillate and pressing of wax from same. The machines used for chilling the distillate are the standard Carbondale Absorption Machines. Since this cut we are considering is in reality a paraffine distillate having pressable qual-

A TRIPLE



Eighteen Bessemer Type-10 two cycle gas engines in one of Carter Oil Company's gasoline plants in the Seminole field. Bessemer two and four cycle engines are built for every oil and gas field service in sizes from 12 ½ to 200 H. P.

A Hope 200 H. P. three cylinder vertical gas engine driving an alternating current generator in oil field service. Hope vertical engines are now built in sizes from 80 to 540 H. P. by the Cooper-Bessemer Corporation for every power service.



Seven 1000 B. H. P. Cooper Gas engines in Houston, pipe lines main line natural gas compressor stations near Edna, Texas. Cooper Four cycle horizontal gas engines are available in sizes from 50 to 1500 B. H. P.

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COOPER - BESSEMER - HOPE

THE *Cooper-Bessemer Corporation* inherits all of the specialized knowledge, all of the rich experience gained by Cooper in the gas field, Bessemer in the oil field, Hope in the power and lighting field. Joined together, these three factors form a triple alliance for greater service, greater research and development, greater reliability and economy in power production.

Ninety-six years ago two Cooper brothers built their first horse-sweep for driving the Cooper cupola at Mt. Vernon. Then came throttling steam engines, locomotives, farm engines, Corliss engines. The first Cooper 4-cycle horizontal gas engine entered compressor service in West Virginia. It is still in constant service, and Cooper has become the leader in furnishing power requirements for the transmission of natural gas through pipe lines. Cooper engines are also in service in refineries, in gasoline plants and in electric plants. In addition, Cooper has been building Diesels.

Thirty years ago the first Bessemer oil field engine entered service in Pennsylvania. Since then Bessemer has been the leading builder of 2-cycle horizontal gas engines for drilling, pumping, pressure work, pipeline pumping, gasoline plants, booster stations, and for power service in refineries. In addition, Bessemer has been an outstanding builder of Diesel oil engines.

Twenty-nine years ago the first Hope 4-cycle vertical gas engine was installed. Twenty-eight years later the Hope was acquired and still further improved by Cooper. Each succeeding year has added to the high prestige of this engine for auxiliary power in main line and booster stations — in gasoline recovery plants — for power and lighting plants — in divers industries.

With these three lines combined and standardized, you can now get a Cooper, a Bessemer or a Hope that meets your conditions exactly.

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ities, it should be carefully processed in order that the white oil stock be of the best quality. An important point which should be kept in mind when first chilling this distillate is not to chill too fast prior to the formation of wax crystals. It is a known fact that better crystalization takes place if some activator is added prior to chilling the distillate. It has been conclusively proved likewise on a plant basis that the crystals build up more uniformly and are purer if the activator is added. In this work, instead of a small percentage of foots oil being added, a low melting point (98°—100° M.P.) wax was added. The results obtained were comparable with those when foots oil was added to heavy paraffine distillate as an activator prior to chilling.

The above mixture of distillate and low melting point wax should be brought to a temperature of 14-16°F. before it is put through the presses. Before this temperature range is obtained, the distillate should first be pumped through a cooler using river water as the cooling medium. This will lower the temperature of the distillate 10 to 12 degrees. Two and sometimes three coolers are used and through each fresh river water should continually circulate. After leaving the coolers the temperature of the distillate will be approximately 82-85°F.

At this point of operation the distillate is pumped through preliminary Carbondale Chilling Machines where the pressed paraffine oil direct from the presses with a temperature of 40°F. is used as the cooling medium. In order that the degree of temperature exchange be as high as possible the warmer unpressed distillate is pumped counter current to the cold pressed oil and this second preliminary cooling chills the unpressed oil to 68°-70°F. On account of the great pressure required to pump the chilled distillate to the press, a by-pass is used in order not to throw too much pressure on any one machine. The last set of Carbondale chillers are connected in parallel with a two-inch connection from a four-inch header. Through these machines circulates the cold brine and the temperature of the outgoing distillate will have been reduced to 14-16°F. From here it is pumped to a storage tank from which it is continually pumped to the presses at such a velocity as the presses can take it.

FILTER PRESS OPERATION

The maximum pressure used to build up the wax on the plates is 950 pounds. In making up a pressure on a press, a full nut should be made up on all the rods furnished for this purpose. This is important for it is essential that a tight joint be made between the rings and plate sof the press in order to prevent the oil from leaking out of the press without putting too great a strain on the rods which hold the press together while filtering takes place.

When the plates of the filter are filled, indicated by the retarded flow of the distillate and a building up of pressure above that allowed, the press is ready to dump. The pressed oil is allowed to run into a trough located beneath the filter and directly in the center. From here it is pumped, while cold, countercurrent to the unpressed distillate through the Carbondale chillers to a storage tank. The wax is dumped from the filter to a ground tank heated with coils and thence pumped to storage tanks for further sweating. The approximate yield of pressed distillate from filters is 92 per cent. and wax eight per cent. The tests on the distillate were as follows: Gravity—30.1°Be; viscosity—86 at 100°F. Saybolt; flash—295°F; fire 355°F; cloud 20°F. At this stage of operation the oil is ready to be redistilled for the white oil stock.

REDISTILLATION FOR WHITE OIL STOCK

This process may be considered one of the most important if not the most importat in the refining of this class of oil. It is at this point that good or bad oil is made and in the redistillation every precaution should be taken not to crack the oil or ruin its quality. In a great many cases where superheated exhaust steam is concerned, a mistake is made in admitting the steam at a much higher temperture than the vapors and boiling point of the vaporizing liquid. It should be kept in mind that the best results are obtained when the temperature of the ingoing steam is just a little higher than the boiling liquid. In other words, it is detrimental to the oil in the still to add to it steam at 500°F. when the temperature of the still is only 320°F. Strange as it may seem, it is a fact that is overlooked more than any other pertaining to distillation. Perhaps the subject of steam in its application to oil distillation is not studied closely enough. This applies to live steam as well as to superheated exhaust steam. The governing process of refining is distillation. The reduction is very flexible on account of the nature of the distillate. It is likewise easily controlled.

For the sake of comparison we will discuss batch still operation and likewise vacuum still operation. Since we are discussing the distillation pertaining to a special product, it may be well worth while to mention some of the precautions which should be taken in order to obtain the best possible results.

The still, together with its setting, piping, valves, condenser and all other equipment, should be carefully inspected by the stillman or his assistant. Any repairs necessary should be made at this time. Assuming that all necessary repairs and inspections have been made and that the apparatus has been found to be in good condition, the following instructions should be followed out before the charging valve on the still is opened.

1. All manhole plates and covers must be fastened securely and properly in their positions on the still.
2. All valves and cocks on the still and on pipe lines connected directly to the still must be closed, except the vacuum and safety valves on the vapor lines. These must be kept open during charging and firing periods. The safety and vacuum valves are to be held open by means of a small piece of wood wedged between each valve and its seat.
3. The tar plug must be properly seated in the still.
4. The relief valve must be closed.
5. Furnace doors must be opened wide and all fire beneath the still removed.
6. A small amount of bottom steam and all avail-

able top steam must be turned into the still for at least 15 minutes before charging is actually started. Bottom steam should be turned off as soon as the bottom steam lines are completely covered by the new charge. Top steam should be used during entire charging period.

As soon as these precautions have been carried out, the division valve on the charging line and the charging valve on the still may be opened and the still charged to an outage which should vary according to the kind of material being charged. In other words the heavier the viscosity of the charge the greater should be the outage in the still. When the correct amount of material has been charged, the charging pump must be stopped and the charging valve and division valve on the charging line must be closed. The top steam should then be turned off.

FIRING FOR STEAM

Firing should be started as soon as the still is charged. It should be maintained at a moderate rate until the still temperature reaches 200-220°F. During this period any moisture in the charge should escape as steam, through the safety and vacuum valves. From time to time the stillman, or his assistant, should draw a sample from the bottom sample cock on the still to determine whether or not water is settling out from the charge. If water does settle out, it should be drained off through the one-inch bottom draw-off line on the still. If steam continues to escape through the safety and vacuum valves when the still temperature reaches 200-220°F. the temperature must be held at this point until steam no longer appears at these valves. When all the water has been removed from the charge, firing may be increased to a maximum and the still temperature brought up to the steaming temperature, at which point bottom steam is introduced to the charge. The steaming temperature is generally around 350°F.

Before admitting bottom steam to the still, the following instructions should be carried out.

1. Safety and vacuum valves should be closed.
2. The relief valve should be opened.
3. Cooling water should be turned into the condenser and on the vapor line sprays.
4. Cooling water should be turned into the top of the relief tank.
5. The running line through the receiving house must be opened to the proper tank.
6. Connections from the main steam line to the bottom steam lines in the still should be completely drained of all condensed water.

For draining condensed water from steam connections to the still the following instructions should be carried out.

1. Open small drain lines between upper and lower regulating valves on both steam feed lines to bottom steam lines.
2. Open upper regulating valves on feed lines, making sure that both lower regulating valves are shut, and allow condensed water to run out until oil appears. Close upper reguating valves.
3. Open lower regulating valves and allow live steam from the main line to blow through drain lines until no more condensed water appears.

As soon as the stillman is satisfied that the steam lines have been completely drained, both upper regulating valves should be opened very slowly. It should require approximately five minutes to open them. Care should be taken during this time that the charge in the still is not "flushed over," through the vapor line, and likewise care should be taken that the safety valve is not blown by the use of too much bottom steam.

As soon as the bottom steam is introduced distillation will begin. As the distillation goes on, the still temperature may be increased slowly, and as the temperature is gradually increased the live bottom steam may be proportionately increased at regular intervals. The still temperature may be controlled by the amount of heat under the still and the amount of bottom steam in the still. There are two methods for controlling a distillation. The first consists in running to a desired viscosity or gravity in the still and the second method consists in running to a definite volume of bottoms in the still. The first method applies to all types of distillation. In this case the pressed distillate is reduced to a certain viscosity bottoms according to the following flow:

Pressed Distillate
Vis/100°F = 86 Flash = 295°
Grav = 30.1°Be Fire = 355°
Cloud = 20°
Charge = 100%

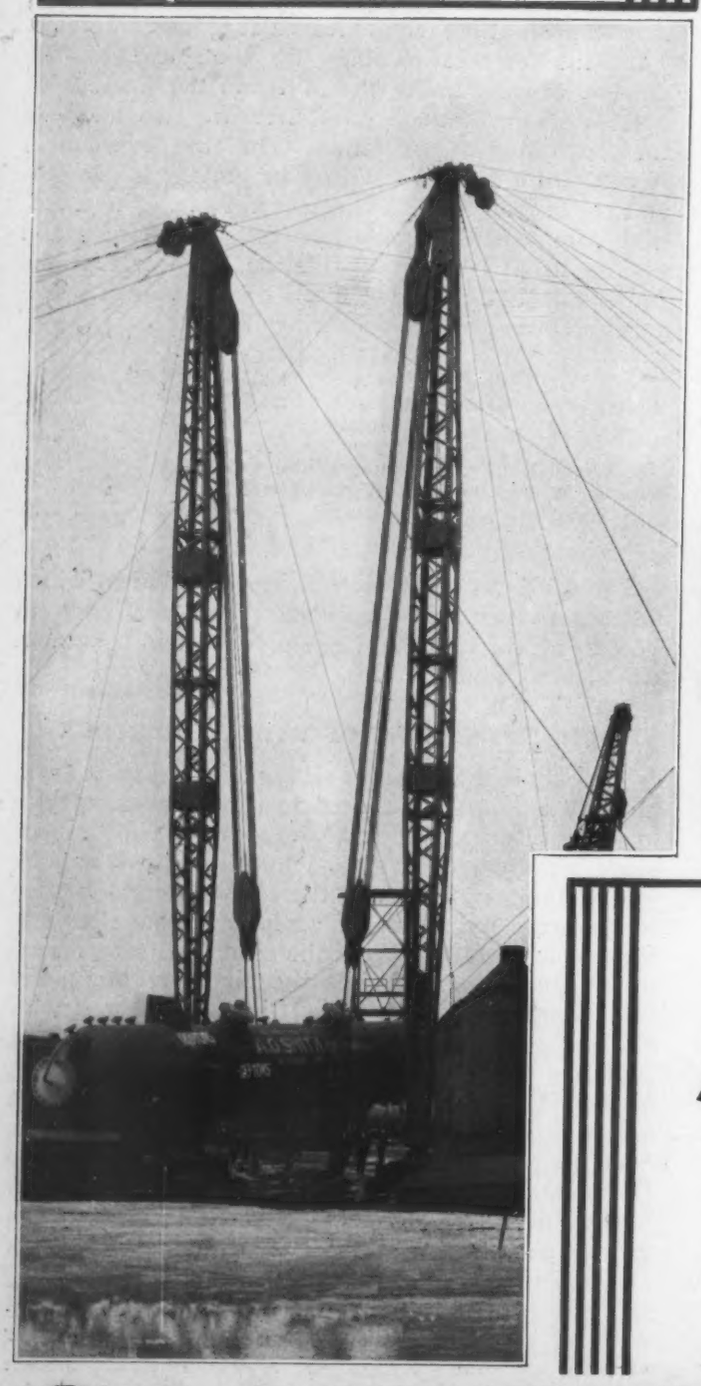
S. W. Dist. over to 38° Be	Pr.Paraf. Oil 38° to Off	White Oil Stock	Loss
8.0%	13.0%	Grav = 28.3° Vis/100 = 85 Fl. = 345°F F. = 400 Cloud = 28 77.6%	1.4%

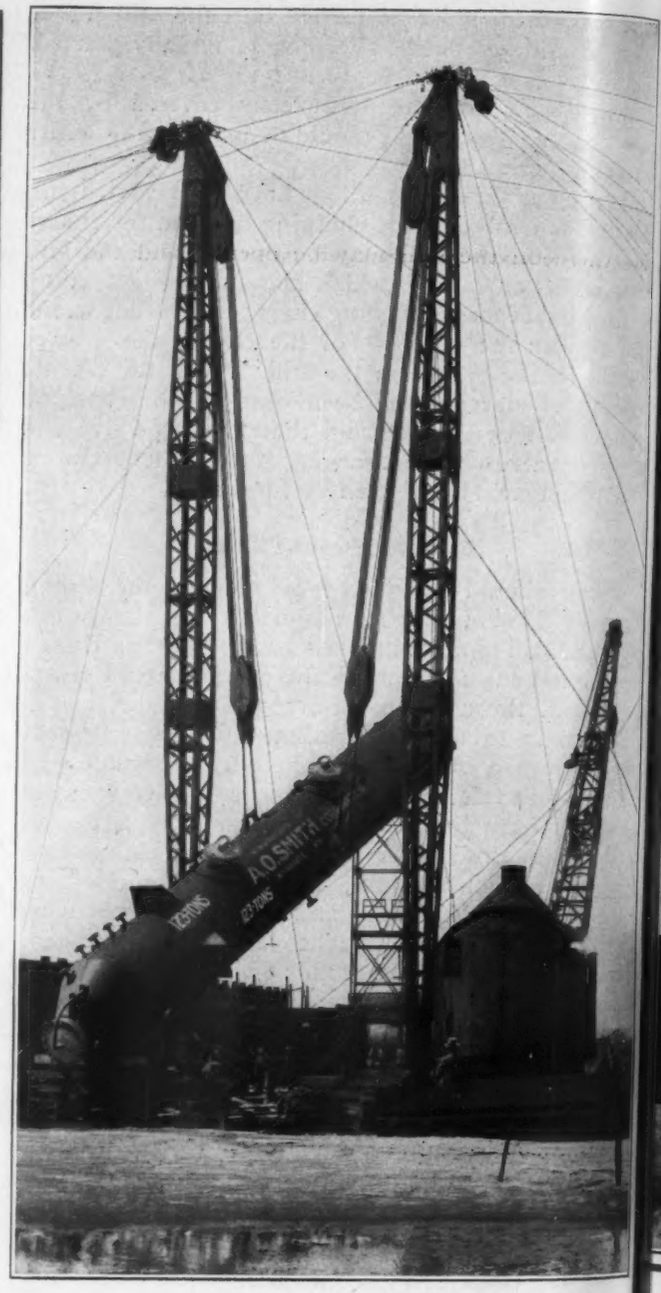
The third cut or White Oil Stock is that in which we are particularly interested. The next step in processing the oil is that of sulphuric acid treatment which is as follows:

ACID TREATMENT OF WHITE OIL STOCK

The required amount of oil for one acid treat (usually 900 barrels) is charged to the treating agitator at a temperature of 60 to 65 degrees F. This temperature represents an average for the winter months but in summer, however, the oil is brought to this temperature by means of cooling. When this has been done, air agitation of the oil is begun by means of air compressor. While the oil is agitating, the first dump of 66° Be. H_2SO_4 having an acidity of 93.5 per cent is blown into the oil. The amount of acid used on the first dump is two per cent by weight of the oil charged. The time required for complete agitation is 45 minutes. At the end of this time the contents of the agitator are allowed to settle five to six hours. The acid sludge is then drawn off at the bottom into a sludge cooking kettle located on the ground near the agitator. When all sludge is off a subsequent dump of four per cent by weight of 66° Be. H_2SO_4 of the same acid content is given the oil with air agitation in like manner as above. After settling six hours longer the sludge is again drawn off. The sludge at this stage of acid treating will be dry and smooth.

The third dump of acid used is 98 per cent H_2SO_4 to the extent of two per cent by weight of oil





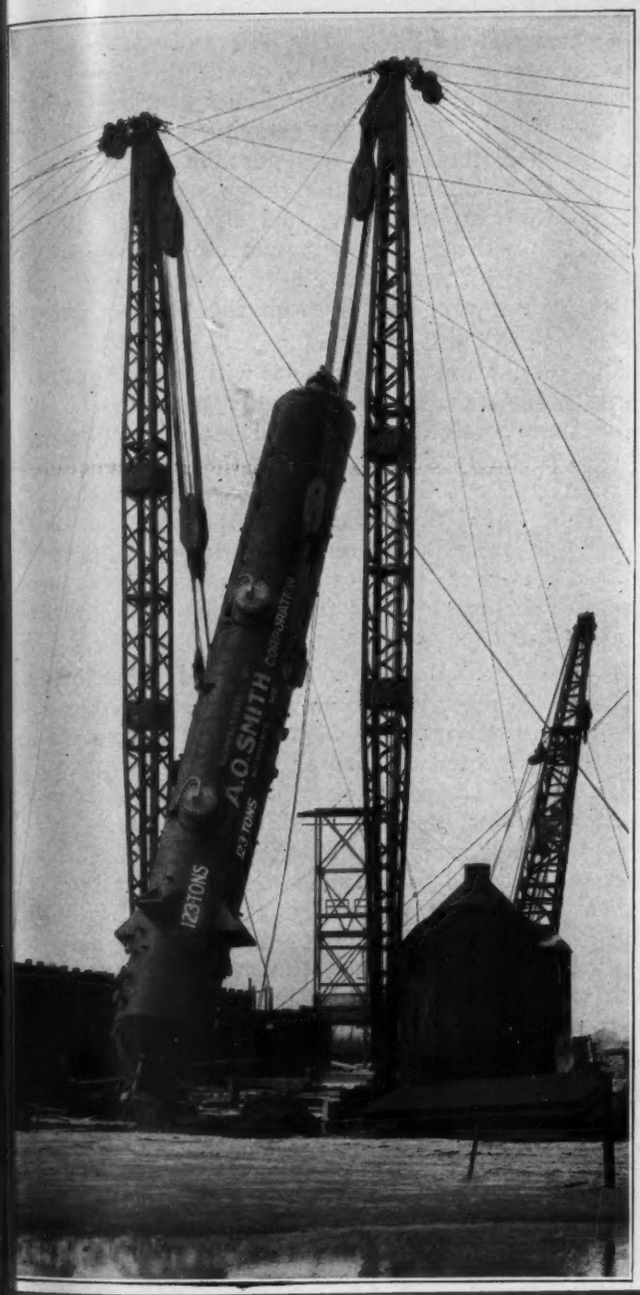
UNLIKE

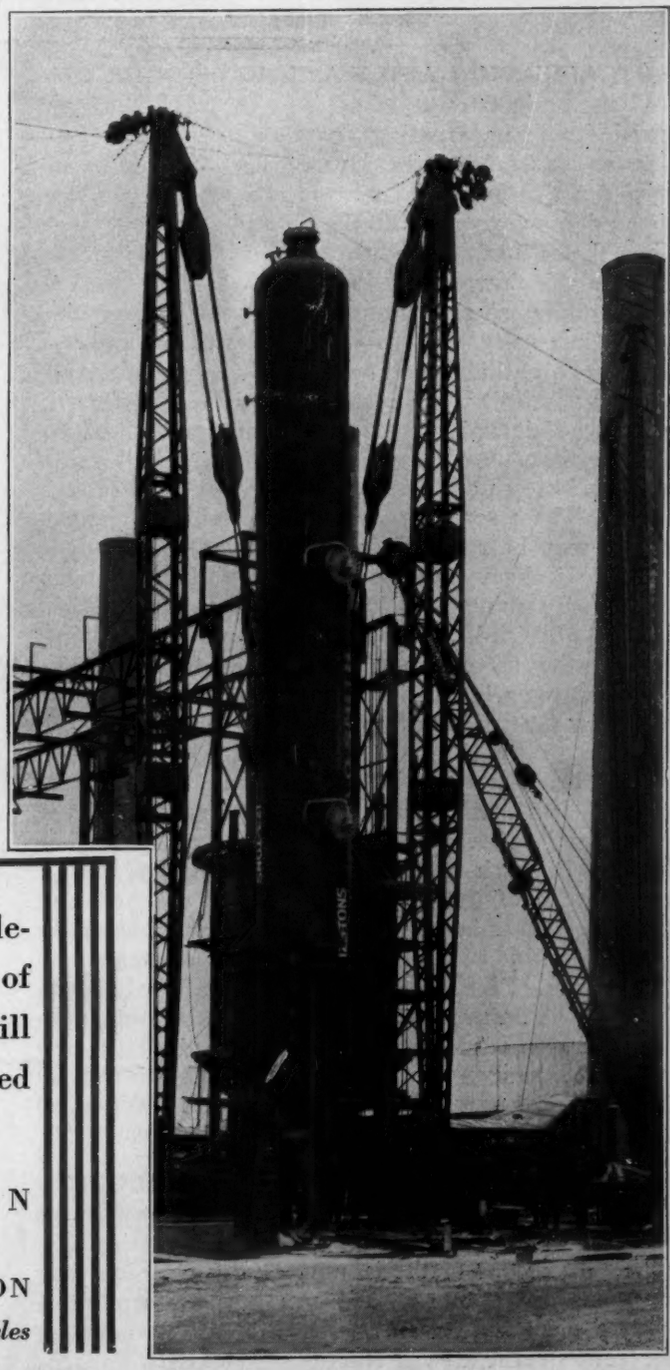
ANY OTHER IN CONSTRUCTION

BUT **LIKE**

ALL THE OTHERS

SMITHWELDED





Unlike any other SMITHWelded vessel in design, but like all the others in the accuracy of construction, this SMITHWelded Cracking Still fitted easily and simply into the place designed and erected for it in advance.

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CRACKING STILLS

charged. In order to insure good treating a sample of the acid should first be tested for acidity. If proved satisfactory the acid is pumped onto the oil while being agitated with air. The time required for blowing in this case is two hours. At the expiration of this time the oil and acid are allowed to settle 12 hours, at the end of which time the acid sludge is again removed. The fourth and last dump of acid given the oil is added to the extent of four per cent by weight of the oil charged of 98 per cent H_2SO_4. Air agitation is used while the acid is being added to the oil. The time of blowing is two hours at the end of which the contents of the agitator are allowed to settle 12 more hours. The action between acid and oil will be considerable. When all sludge has been removed the oil is ready for neutralization.

NEUTRALIZATION AND WASHING OF SOUR OIL

When the last traces of acid sludge have been removed from the treating agitator, set the correct lines for transferring the sour oil and make sure all division valves on the agitator are closed. Lower the suction swing line into the oil and start pumping. When the oil has reached the wash agitator, regulate the soda ash flow, which is tied into the oil suction on the pump, so that a sample taken from the discharge line, as well as from the agitator, and tested with phenolphthalein, shows a slight pink color, indicating alkalinity. When all the oil is transferred, close the soda valve. Allow the neutralized oil to stand five to seven hours and then draw off all soaps from the bottom of the agitator previous to washing the oil. These soaps are purely sulphonic in character and may be retained for further use.

After the heavy sulphonic (or naphthenic) soaps have been removed, make sure that the remaining oil is neutralized. This may be done by agitating the oil a few minutes by means of air; taking an average sample while agitation is going on. Shut off the air and turn open steam on the oil and observe from the top of the agitator its action upon the oil. If a tendency to emulsify occurs, shut off the steam and allow to settle. Draw off any soaps that have settled and re-steam. When indications show that the oil will wash without emulsifying, steam until a temperature of 160-170° F. has been reached and steam for 45 minutes longer. Add approximately 20 per cent by volume, of hot water and steam one hour longer. Shut off all agitation and allow to settle six to eight hours. Draw off milk-water and pump the oil to the bleachers to be brightened. This step involves blowing all the moisture from the oil by means of air at the washing temperature. When oil is bright it is ready for vacuum distillation.

REDISTILLATION OF OIL UNDER A VACUUM

The type of still used for this purpose was the standard vacuum type with a ball fractionating column. By means of the column a very close cut was made. The first 10 per cent over was run separately from the column into a running tank. The next 40 per cent overhead was fractionated closely and run into a separate running tank. The next 10 per cent was likewise cut into a separate running tank, making in all three distinct cuts for blending as the case called for. This was found to be advantageous instead of running 60 per cent into one tank, for reasons mentioned later. The object of vacuum distillation was to save the color of the distillates and to prevent the body of overhead cuts from becoming changed and unstable. By carrying out the above method of distillation it was possible to produce a product of a "short" boiling range and it was likewise possible to study the real effect of fractionation. No evidence has been determined to indicate that such an oil would have better properties than a wider boiling range aside from the obvious differences of flash point.

An examination of the results will show that fractional distillation gives uniformly better yields to color than straight or fire and steam distillation. This is probably due to the fact that fractional distillation cuts out the higher boiling compounds. It should be noted that when the cuts from fractional distillation are mixed, the effect is to partially neutralize whatever changes fractionation may have made, since the object of fractionation is to produce a product of a "short" boiling range.

Moreover, results show conclusively that better yields as to color are obtained by acid treating the oil before distilling. It was found that during distillation of a treated oil a small amount of sulphur dioxide was liberated. Upon long standing the oils went off color and darkened considerably. However, the color seemed to be due to a colloidal condition present and was, fortunately, readily removed by clay treatment which also removed all undesirable odor from the oil. The filtered oil did not darken on long standing. It may be mentioned here that caustic soda for neutralization of sour oil may likewise be used but with care and in not excessive quantity. The final step in the production of white oils is clay filtration.

APPLICATION OF CLAY TO OILS

The selection of clay is of vital importance prior to its application in filtering oils. No absolute conclusion as to the decolorizing property of a clay can be drawn from the physical properties or the chemical composition of the clay, although in many instances a light weight clay will be found better than a heavy clay. The decolorizing power of a clay towards a given stock is independent of its volatile matter contents, as long as this does not consist of hygroscopic water. A clay should be burned at such temperature that the burnt clay has a minimum friability without having lost its porosity. In studying the influence of the rate of heating the clay to the desired burning temperature, it may be concluded that the rate at which clay is heated to the desired burning temperature in the kiln, does not affect the ultimate volatile matter in the burned clay to a degree beyond permissable limits.

Reburning a clay at the same temperature as that of the first burning, does not change the volatile matter contents. Although it is generally assumed that a burnt clay of low weight per cubic foot has a greater decolorizing activity than a heavier clay, there are numerous exceptions to this assumption. The decrease of the decolorizing power of a clay is

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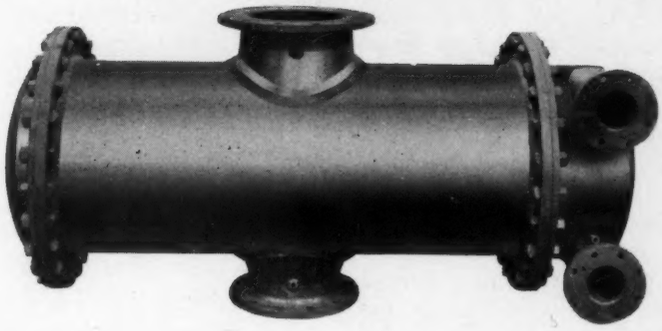

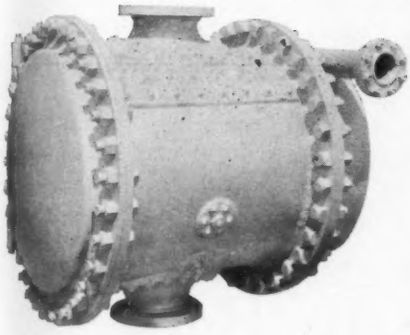

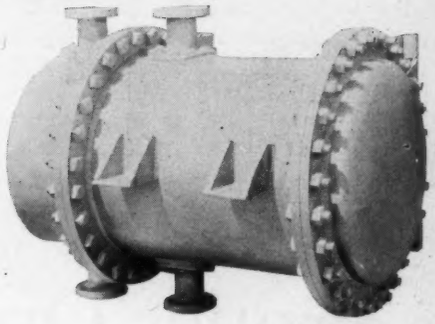

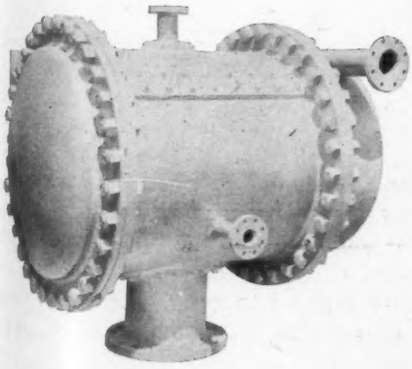

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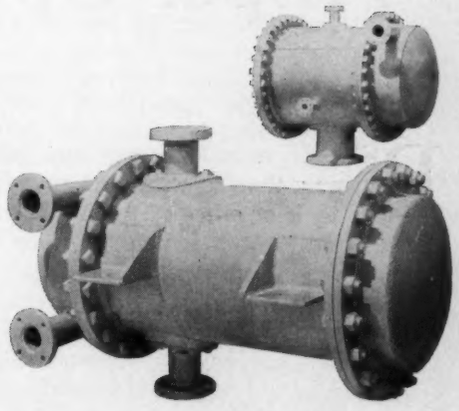

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not caused by the accumulation of carbon or by any sintering of the clay due to heating. It is probable that the heating of the clay in the presence of carbon causes changes in the composition of its surface that lowers the absorption power of the same.

For this work a 10-ton filter has proved very satisfactory. After the bottom canvas has been laid in position and a weight ring placed upon it, the clay chute is opened to allow the clay to run into the filter from a hopper situated on the floor above. When the filter is charged to approximately 18 inches outage, a top canvas is carefully placed in position and a thin iron weight ring laid upon it. Both bottom and top layers of canvas should be turned up slightly around their entire circumference. The filter is finally charged to one foot outage. From storage tanks the oil as prepared above is charged by means of a pump overhead to the filter. A return line to the storage tank is provided to prevent the pressure building up too high on the filter. Channeling of the oil will be eliminated if care has been exercised in charging filter.

The head pressure of the oil thus maintained in the filter causes the oil to percolate downward through the clay and out the bottom to run-down tanks. From these the oil is pumped to storage tanks as a finished product. The oil is allowed to run into the pans as long as the color is +20 Saybolt or better. When the stream starts to go off color the light color oil is pumped away to storage and the filter is allowed to drain until no more oil runs into the pan. This oil is used as refilter charging stock. The tests on the finished oil are as follows: Color—+20 Saybolt; gravity—30.5° Be.; viscosity at 100°F—76; flash—350°F; fire—395°F; iodine number by addition—0.73; by substitution—14.5; British sludge test 1.147 and 1.156.

On exposure to light for 30 days no apparent change in color was observed. On being kept in darkness for two weeks and then exposed to light for the same period no color change was observed. The oils were, therefore, considered stable products.

Before closing this article I should like to mention that another light intermediate distillate from a Mid-Continent crude was used with marked success and likewise a 60-70 viscosity at 100° F Saybolt distillate from a pure napthenic base oil gave very satisfactory results throughout the processing. All finished oils were permanent to light and heat.

White oils having a viscosity of 70-80 Saybolt can be made from stocks designated and used above.

The finished oils will be permanent to light. The sludge tests will be at a minimum, as well as the iodine tests. The oils as prepared above were odorless and remained so.

Fractionation under a vacuum gives better yields as to color than fire and steam distillation.

Acid treating before fractional distillation gives better yields than treating after distillation.

The demand for permanent white oils is greater today than ever and although the above method of processing may seem long and complicated, it actually is producing on a commercial basis good quality oils which are permanent to light and heat and are, therefore, stable products.

Proper Operation of Steam Boilers

By B. F. SPIGENER*

BEFORE a boiler is put into service it should be given a thorough internal examination to see that no tools or other refuse has been left inside when the installation was completed. For both new and repaired boilers, care must be taken to remove grease left on the internal surface. Grease spots occur from use of oily waste, as well as from lubrication of tools and air motors used in repair and construction. Oil allowed to remain in boiler retards the transmission of heat through the plates and tubes and may lead to overheating, with damage by bulging or rupture of the metal.

Before a new or repaired boiler is put in service, it should be either boiled out under pressure, or filled with water and brought to the boiling point. To the water should be added sodium carbonate, known also as soda ash, or washing soda, in the proportion of one pound of soda to 20 gallons of water.

The soda ash should be dissolved in water before it is introduced into the feed water. If the boiling out is done under pressure, the water level should not be above the top gauge cock, and the pressure should not exceed 20 pounds per square inch for high pressure boilers.

The scum blow off should be opened frequently to remove the oil or grease brought to the surface.

Before water is admitted into the boiler, preparatory to geting up steam, the manhole plate and handhole covers should be examined to see that they are properly seated and that the gasket joints are in good condition.

The gasket may be set in white lead, and if a mixture of graphite and cylinder oil is placed on the outer face of the gasket it may be removed at several cleanings without tearing; thus it is possible to use the same gasket again and again.

In filling a boiler with water, it is necessary to make provision for the escape of air, otherwise the accumulation of air will prevent the water from flowing in to the proper height.

The boiler therefore must be vented by opening some valve above the desired water level. The safety valve may be raised from its seat or the top gauge cock may be left open until steam issues from it. There are a

*Read before foremen's meeting of the Columbian Gasoline Corporation, Monroe, Louisiana.

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number of methods of filling the boiler, the location of the plant and existing conditions determine just which method is to be followed. The boiler should be filled until the water shows half way up in the gauge glass, assuming that the latter has been properly placed. In any case, the water should be high enough to cover to a depth of at least two inches all parts of the boiler that are subjected to the action of the fire and hot gases on the outside.

It should be borne in mind that when getting up steam, the fire should not be forced, instead, it should be allowed to burn up gradually, thus giving the boiler a chance to expand uniformly under the action of the increasing temperature.

By forcing the fire, the plates or tubes nearest the fire suffer extreme expansion, while those parts that are remote from the fire are still cold; under such conditions the seams and rivets, and also the tube ends, which are expanded into the tube plates, are liable to be severely strained, and possibly permanently injured.

After the pressure at which the boiler is to run has been reached, but before putting it in service, all the valves and cocks should be tried under pressure. The safety valve should be raised and its action noted; the water column should be blown out and the gauge cocks tested; the feeding apparatus should be tried; and it should be noted particularly whether the check valve seats properly and the valve in the feed pipe is open. All the accessible parts should be examined for leaks. When everything is proved to be in good order the boiler is ready to be cut in line.

Cutting a boiler into service is accomplished by opening the stop valve, thus permitting the steam to flow into the main steam pipe. The stop valve, and in fact any valve subjected to great pressure, should be opened very slowly to prevent too sudden a change in the temperature. And expansion of the piping through which the steam flows, and to prevent water hammer. The latter is caused by the rush of steam, which picks up the condensation in the pipe and carries it forward at high velocity. When this water strikes a fitting, the heavy blow due to the momentum of water moving with a high velocity is likely to cause a leaking of the joints if not a breaking of the pipe. To prevent the accumulation of water, the steam pipe drain should be kept open until the pipe is thoroughly warmed up, that is, until nothing but steam issues from the drain. In case the boiler is fitted with a stopvalve and a non-return valve, steam is raised slowly until the pressure is about 10 pounds lower than in the main. The main stop valve is then opened, and all condensation between the stop valve and non-return is blown out. Then the spindle of the non-return is raised, and when the pressure in the boiler equals that in the main, the boiler will be automatically cut in by the action of the non-return valve.

WATER TUBE BOILERS

Water tube boilers are not as easily washed out with a hose as are boilers of the fire tube type. The only thorough way of washing out a water tube boiler is to introduce the hose-nozzle into each tube and commencing at the top to wash out the contents which fall into the mud drum.

This method consumes considerable time, but it pays, provided the time can be spared. The scale that accumulates on the inside of the tube in water tube boilers is commonly removed by rotary tube cleaners. When mechanical hammers or cleaners are employed for removing scales from tubes, the pressure used to operate them should be as low as will suffice to do the work.

Do not allow the cleaner to operate for more than a few seconds on any one spot, and see that it goes entirely through the tube. Avoid high temperature in the steam or water used to operate the cleaners.

The length of time that a boiler may be continued in service without cleaning depends on several conditions, such as whether the boiler is the only one in the plant, the nature of water used, local conditions governing plant operates on Sunday and holidays. In general, the operation of the boilers, and whether or not the when a boiler has been in continuous service from four to eight weeks, it should be cut out of service, thoroughly cleaned internally and externally, and the necessary repair should be made.

In plants in which more than one boiler is used, so that it is possible to cut one out of service for a time, shorter operating periods are possible. After the boiler has been cut out of service by closing the steam stop valve, thus closing communication between the boiler and the main steam pipe and after closing the feed valve, the fire is cut out and the boiler is allowed to cool. When the boiler has cooled sufficiently, the water is run out through the bottom blow off, the manhole covers are removed. The boiler is then thoroughly cleaned internally and examined for corrosion, wasted plates, broken stays, seam cracks, and other defects.

A Loading Rack Foreman's "Trouble With the Railroads"

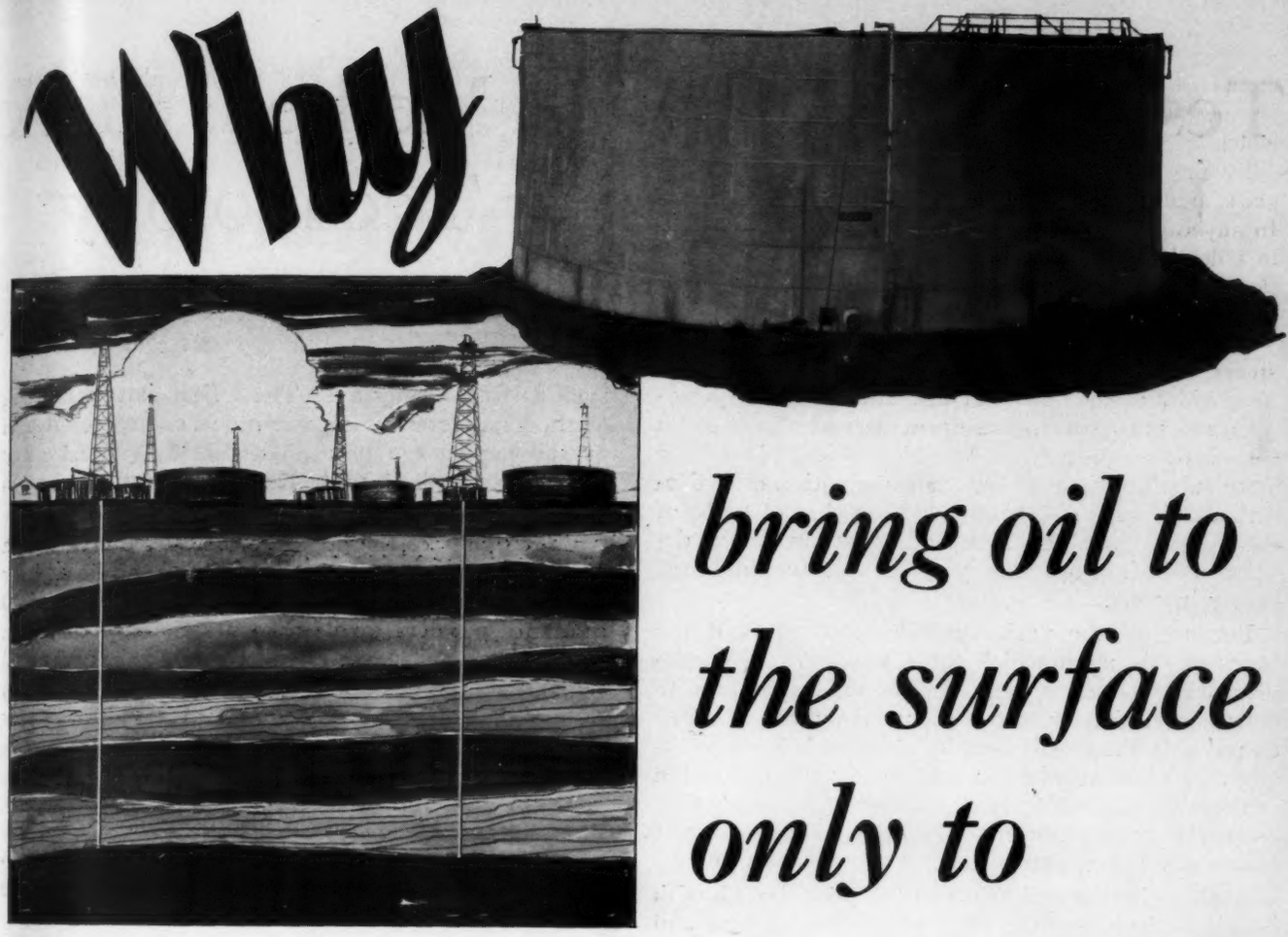
Walking up to the "dog-house" on the loading rack of a larger West Coast refinery the writer "got in" on the last of a healthy argument between a hard-headed switch crew foreman and a none-too-docile loading rack foreman. The switch boss complained that some one on the rack was permitting his men to take gasoline for their private autos — and that the L. R. foreman ought to have the "permittee" fired forthwith.

The loading rack "director" explained that he knew nothing about it by the simple method of using five or 10 cuss words interspersed among three or four fairly nice words. There was no misunderstanding about where the switch boss could go.

Just why the foreman of the switching crew could not have gasoline along with his men could not be discovered. Evidently he was not popular at the loading rack.

"What the blankety blank sort of an idea do you suppose that guy has anyhow?" asked the loading rack foreman as we took a bench in the dog house. "I'm always havin' all sorts of trouble with the railroads. Here now this double blank bird reports me to myself for giving away gasoline to his gang, and then has the nerve to insist that I fire myself or have it done. Now what tha?" — (more blanks — plenty of them.) "If he ever does get any gasoline outa me he'll darn sure have to furnish his own can."

Why



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Philadelphia.....1608 Jefferson Bldg.
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EVAPORATION LOSSES

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Testing and Analytical Methods Mark Progress in Refining Technology

By H. L. KAUFFMAN

IN view of the fact that our knowledge of petroleum products increases in almost direct ratio with the progress made in deveolping newer and more suitable methods for the examination of hydrocarbon oils, it was felt that a discussion of some of the foremost analytical methods that have been developed during the past year or two would be of timely interest.

Because of the variety of the methods and the types of oils upon which those methods are particularly adaptable, it will be almost impossible to discuss them in any sort of order. However, as much as possible there will first be discussed those methods that give information concerning the utilization of the oil; later, those more theoretical methods that are useful principally in advancing our knowledge of hydrocarbon chemistry.

Asphalt in mineral oils can be precipitated with benzine, alcohol-ether, amyl alcohol, butanone and ethyl acetate. Marcusson states (Chem. Ztg. 190 (1927); Brenn.—Chem., (Sept. 1, 1927), that the values for the benzine and amyl-alcohol determinations vary, in one case, from 0.9 to 22.4 per cent.

Marcusson then goes on to describe the following method for determining the asphaltenes in mineral oil by the use of iron chloride:

Five grams of oil are dissolved in 50 cc. of ethyl ether. Then 5 cc. of a five per cent. solution of iron chloride is added. After two hours the precipitate is filtered off and washed once with ether. The dry filter is extracted with ether as long as anything goes into solution. The iron double compound is now dissolved with chloroform and shaken in a separatory funnel—first with 5 cc. of dilute hydrochloric acid and then with 5 cc. of water. The chloroform solution is then separated and the chloroform evaporated. The asphalt is dried at 105°C. and weighed.

Marcusson states that a comparison of the results of this method with the benzine precipitation method, on different oils, shows the following:

Benzine:	0.09	0.13	0.21	0.30	0.35	0.41	0.90
Iron Chloride ...	0.47	0.94	1.10	1.38	0.99	1.37	2.80

Marcusson further adds that the new method is quantitative, simple and reasonable; but, of course, does not give the same values as the benzine precipitation number.

ASPHALTIC INDEX OF TRANSFORMER OILS

An anonymous writer (Industr. Ital. Olii Transform. 11, Aug. 1926, p. 4; Chim et. ind., Jan. 1928) describes the method given in the following paragraph for determining the asphaltic index of oils, such as transformer oils. The writer states that this method for determining the index of auto-oxidation or the percentage of asphaltic acids formed gives results concordant with Kissling's method, but is more rapid. He proposes the following method:

Fifty grams of the oil to be tested are placed in a 200 cc. Erlenmeyer flask. The oil is then heated for 24 hours at 120°C. (248°F.) in the presence of 10 grams of pumice-stone fragments the size of a pea, which fragments have been previously impregnated with sodium hydroxide by being placed in a solution of 0.7 gram of sodium hydroxide per 10 cc. of water and then dried at 105°C. (221°F.). After cooling, the oil is re-heated on the water bath for 20 minutes with 50 cc. of Kissling's reagent, a mixture of equal parts of water and 7.5 per cent. alcoholic soda. The whole is then shaken for five minutes, after which the alcoholic solution is separated and the asphaltic acids are extracted by means of benzine.

RESISTANCE OF AN INSULATING OIL

Bukton states (Erdol u. Teer, 3, 123 (1927); Chim. et. ind., Jan., 1928) that the methods of test based upon heating an oil for a long time in the presence of oxidants are considered best for determining the ease with which mineral oils are oxidized. In order to reduce the time of the tests, which is always more than 70 hours, Bukton proposes to use the oxygen under pressure, employing an autoclave heated by an oil bath for this purpose. The samples of 6 cc. of oil are contained in thick-glass test tubes. The gas at a pressure of 15 kilograms is circulated at the rate of five liters per hour for not over two hours at 150°C. Bukton states that concordant results are obtained and in a much shorter time than by the other method. He adds, however, that on account of the important influence of the free surface of the oil, it is imperative that only tubes that are absolutely uniform in diameter be used.

The oxygen number is defined by Nametkin and Abakumovsky (J. Prakt. Chem., 115, 56 (1927) as being the active oxygen necessary for the oxidation of 100 grams of substance, by means of benzoyl hydrogen peroxide, and is a measure of the unsaturated hydrocarban content.

In making the determination Nametkin and Abakumovsky state that the following suggestions should be considered:

About a 0.5 N chloroform of benzoyl hydrogen peroxide should be used, at a temperature of between 9° and 12°C., in the dark, for between 40 and 48

SHORTEST
shutdown time for cleaning

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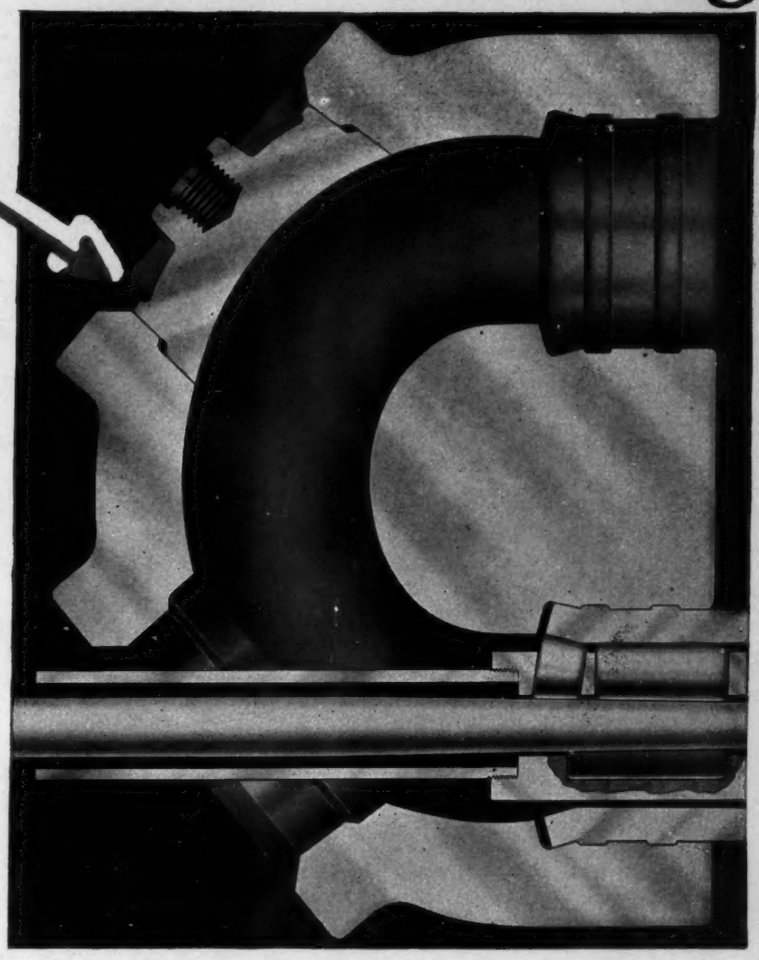

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Ample clearance for rolling and cleaning tools.

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Simple design and durable construction from electric alloy steel of high tensile strength and ductility.

Built for any practical refinery working pressure . . . tested to insure perfect tightness at pressures greatly in excess of service requirements.

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hours. The freshly prepared peroxide should be allowed to stand for from one to two days before using. The unsaturation coefficient is defined as 100/16 Oxygen Number or 100/254 Iodine Number.

The following figures represent the density at 15°F. (59°F.), boiling-point range, iodine number, oxygen number, and the unsaturation coefficients from the two latter, on a number of different oils.

Oil	Dens. at 15°C.	Boiling range	Iodine number	Oxygen number	Unsatn. coeff. fr. I. No.	Unsatn. coeff. fr. O. No.
Cracked benzine	0.743	68-210°	148.0	8.48	58.2	53.0
Baku benzine (2d. class)	0.759	86-203°	3.28	0.18	1.2	1.1
Motor gasoline Standard Oil Company	0.741	48-220°	18.8	1.52	7.4	9.5
Tide Water Oil Company	0.752	57.5-218°	29.1	1.47	7.0	9.1
Sinclair Refining Company	0.752	46.5-221°	34.0	2.75	13.4	17.2
The Texas Company	0.751	40.5-223.5°	50.5	3.03	19.9	18.9
Kerosene distillate (Emba)	0.823	125-311°	5.31	0.61	2.1	3.8
Baku kerosene	0.825	139-322°	11.23	0.825	4.4	5.1
Std. White kerosene (Texas Co.)	0.801	138-292°	11.59	0.89	4.6	5.6
Water White kerosene Standard Oil Company	0.807	133-276°	27.04	1.77	10.6	11.1

For the following lubricating oils, density at 15°C., flash point, asphalt content, iodine number, oxygen number and unsaturation coefficients are given.

Oil	Dens. at 15°F	Flash point	Asphalt Content	I. No.	O. No.	Unsatn. coeff. fr. I No.	Unsatn. coeff. fr. O. No.
Emba Oils:							
solar oil	0.880	131°	2.0	10.78	1.63	4.2	10.3
spindle oil	0.895	185°	5.0	15.98	2.12	6.3	13.3
machine oil	0.899	210°	6.0	16.87	2.39	6.7	14.9
transformer oil	0.882	165°	0.0	8.7	0.63	3.4	3.9
turbine oil	0.896	188°	1.8	13.15	1.00	5.2	6.3
machine oil	0.898	212°	3.0	15.04	1.28	5.9	8.0
Baku Oils:							
transformer oil	0.895	150°	1.0	11.38	1.21	4.5	7.6
turbine oil No. 18	0.898	164°	3.2	15.08	1.52	5.9	9.5
machine oil	0.909	186°	4.6	17.97	1.64	7.1	10.3
cylinder oil No. 26	0.914	202°	5.6	20.29	1.86	7.9	11.7
vapor 3	0.917	240°	12.0	19.88	1.95	7.8	12.2

NEW SULFURIC-ACID METHODS

Kattwinkel (Brennstoff-Chemie, Nov. 15, 1927) states that according to Riesenfeld and Bandte's findings, the dimethylsulfate method of determining aromatics in gasoline always gives too high results. The Egloff method, a nitration method in which the nitro-derivatives form an intermediate layer between the sulfuric acid and the unchanged gasoline, gives values too low when the aromatic content is small and values too high when the aromatic content is large. By the Hess method, which depends upon the conversion of the aromatics into mono-nitroderivatives and the solubility of these in sulfuric acid, satisfactory values are obtained for gasolines of low aromatic content, but for a content of 25 per cent. or more the values obtained are too low.

To determine unsaturates, Riesenfeld and Bandte use 94 per cent. sulfuric acid in testing medium and heavy gasolines and 92 per cent. acid in testing light gasolines. These concentrations of acid are recommended for use only when testing straight-run gasolines; for cracked and lignite gasolines, the use of acid of 85 per cent. strength is preferable.

In determining aromatic and unsaturated hydrocarbons in cracked and lignite gasolines, Riesenfeld and Bandte found that heating was not necessary in order to start the reaction. These gasolines contain larger quantities of paraffin hydrocarbons containing teritary carbon atoms than do straight-run gasolines, which are composed mainly of straight-chain compounds. The former react preceptibly with 100 per cent. sulfuric acid at 40°C; but Riesenfeld and Bandte obtained correct results when they tested their method at room temperature.

Kattwinkel found in previous work that adding boric acid in the sulfuric acid washing of crude benzol kept down the reaction temperature. Later, Kattwinkel learned that phosphorous pentoxide exercised a protective action against too strong an attack by sulfuric acid, notwithstanding the fact that phosphorous pentoxide is generally an accelerator and not a retardent of reaction.

The following four acid combinations were therefore tested by Kattwinkel upon synthetic benzol-gasoline mixtures as to their suitability for sulfonating and dissolving out the benzol:

1. Sulfuric acid of 1.84 specific gravity.

2. Twenty grams of boric acid in 100 cc. of 1.84 sulfuric acid.

3. Twenty grams of phosphorous pentoxide in 100 cc. of 1.84 sulfuric acid.

4. Forty grams of phosphorous pentoxide in 100 cc. of 1.84 sulfuric acid.

The last-named mixture could be used on hydrocarbon mixtures containing up to 50 per cent. of benzol. Above this percentage it was necessary to dilute the mixture with Kahlbaum's standard benzine. A reagent for unsaturates consisting of five grams of boric acid in 100 cc. of 1.84 sulfuric acid was also tried on mixtures of benzol and benzine with amylene.

As a result of the data gathered, Kattwinkel proposed the following method for determining aromatic and unsaturated hydrocarbons:

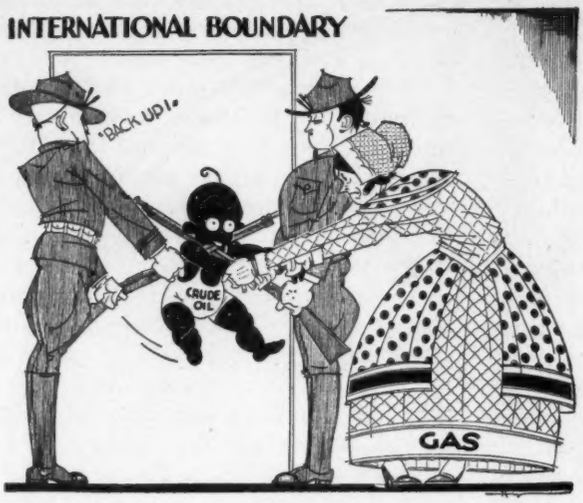
Thirty grams of phosphorous pentoxide are dissolved in 100 cc. of 1.84 sulfuric acid. Thirty cc. of this mixture is used to treat 10 cc. of the gasoline to be tested. If, in thoroughly shaking the two together, the temperature rises to that of the hand or above, the determination must be made on a sample obtained by diluting half with standard benzine. The sample and reagent are shaken continuously for five minutes. The increase in volume of acid, read at the end of one-half hour, gives the content of unsaturates and aromatics. To obtain the unsaturates alone, the boric acid-sulfuric acid reagent is used, following the same procedure as before. The apparatus is allowed to stand over night before taking the reading. The temperature does not rise until an unsaturated hydrocarbon content of about 30 per cent. is reached.

AROMATIC HYDROCARBONS BY THE SPIRIT VALUE

Dietrich (Autotechnik, No. 18, 1927, p. 17; Edrol u. Teer, Oct. 13, 1927, p. 665) defines the spirit value as being the critical solution temperature of a mixture of seven parts by weight of gasoline and three parts by weight of 96 per cent. alcohol.

Dietrich states that in this work of investigating the influence of the several classes of hydrocarbons upon the spirit value of a gasoline, it was established that the unsaturated hydrocarbons in straight-run

Billions of Bubbles



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gasolines shift the spirit value to higher or lower temperatures in an incalculable manner. In highly unsaturated gasolines, the removal of the unsaturates raises the spirit value considerably. The apparently arbitrary influence of the unsaturates upon the spirit value may possibly be explained by the differing solvent power of the alcohol for different classes of unsaturates. The aromatics show a consistent effect upon the spirit value, causing it to drop proportionately to the aromatic content. The proportional relation of the naphthenes and paraffinic hydrocarbons is decisive for the height of the spirit value of the residue left after the removal of unsaturates and aromatics. In general, the higher the paraffin content, the higher the spirit value.

In the original article by Dietrich, the curves presented therewith (in answer to the question whether by the use of spirits of different strengths, the solvent power for definite classes of substances is brought out) show that with gasolines in which one or another class of hydrocarbons predominates, special irregularities may be recognized in the curve. This permits conclusions to be drawn as to the presence of certain compounds.

Dietrich finds that there is a measure of interrelation between spirit value and resistance to knocking; and that all gasolines that have an unsually high content of unsaturates show irregular behavior with reference to knock resistance.

DETERMINATION OF THE VOLATILITY OF GASOLINE

During the past two years the volatility of gasoline has been shown definitely to be one of the most important indices as to the quality of gasoline.

Stevenson and Babor showed, in a paper read at the Detroit meeting of the American Chemical Society (Sept. 5-12, 1927), that the dewpoint is the best indication of the temperature of complete vaporization, under equilibrium conditions, of gasoline either alone or when mixed with air.

These investigators found that the dew-point can be determined by means of an optical effect shown by a new device called the black-surface dew indicator, whereby the determinations are made easily, rapidly and reliably. The disadvantage of actually determining the dew-points of the different air-fuel mixtures may be avoided by the use of a graph showing the relation between the dew-point of the gasoline alone at 760 mm. pressure and the dew-points of the different air-gasoline mixtures. This equilibrium end-point or dew point of gasoline alone is particularly easy to determine with the black-surface dew indicator and its relation to the dew-point of the air-gasoline mixture is sufficiently definite for their derivation by means of a graph with practical accuracy. In this way one simple determination of the new-point of gasoline alone suffices for the deduction of the temperatures of complete vaporization of all the practical air-gasoline mixtures.

BITUMINOUS EMULSIONS

Mallison (Erdol u. Teer, Jan. 15, 1928, p. 27) states that a bituminous emulsion for road-building must be stable in storage and must not coagulate in transit to the place where it is to be used. On the other hand, it should break when it is placed upon the road surface or mixed with the rock; that is, the binding agent, tar or bitumen must separate out in coagulated form. Requirements differ according to the particular purpose to be served. The breaking of an emulsion is produced or is favored by contact with the large surface of the rock material and by loss of water in consequence of evaporation and seeping away.

Mallison has developed the fact that any method of testing the resistance to breaking of a bituminous emulsion should be adapted to and imitate as nearly as possible the actual conditions on the road. Likewise, Mallison has worked out such a method which has proved entirely satisfactory in determining the stability of an emulsion.

As a preliminary test a small quantity of the emulsion is streaked on to a piece of filter paper with a glass rod. After allowing it to penetrate, a drop of water is placed on the bitumen, and note is taken of whether the latter remains unchanged or tends to spread out because the emulsion is difficult to break.

For the more exact determination, the water content of the emulsion is first determined by distilling with xylol. The content of the emulsifying agency being generally very small the percentage of bituminous binding agent is found by difference. A surface 10 centimeters square is outlined on a clean glass plate with pitch; 10 grams of the emulsion is spread evenly on the square space, and fine sand is strewn over it. The quantity of sand will depend upon the bitumen or tar content of the emulsion; five grams of sand is used to one gram of bitumen or tar. The plate is weighed accurately and placed in a level position at room-temperatures. The loss of water is followed by weighing at intervals, and the drying is stopped, say, when 50 per cent. to 80 per cent of the water content has been lost. After testing the external condition of the layer and the softness by dabbing and pressing with the finger, the plate is placed at an angle of 45° in water at 20°C. for 24 hours. If at the end of this time the bituminous layer still adheres firmly to the plate, the latter is held in a level position under a vertical spray of water for 20 minutes and note is again taken of whether the layer is detached or not.

Experience has shown that this method of testing gives a good idea of the stability of an emulsion. Preparations which easily spread in the filter paper in the preliminary test differentiate themselves clearly from emulsions that break readily. There are emulsions that adhere firmly after losing 50 per cent. of the water; others do not do so till after losing 80 per cent.; others again withstand the immersion in water but not the subsequent use of the spray. Pieces of stone can be used for the test instead of glass.

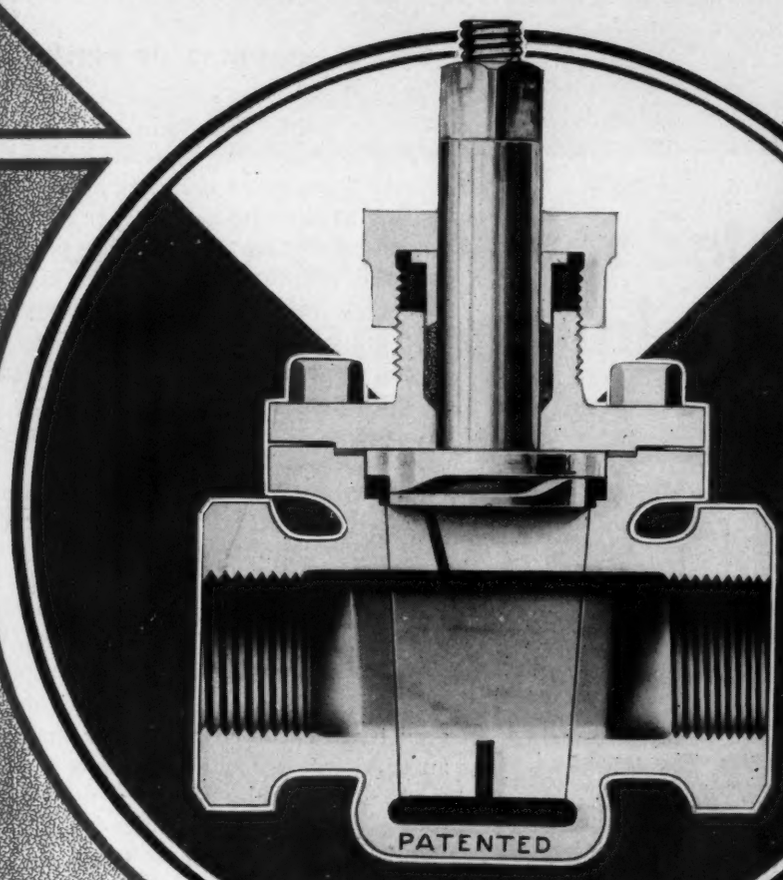
The method does not give a standard for a reparation, but only a measure of stability. What degree of stability is needed depends upon the specific conditions under which the emulsion is to be applied.

DIRECT OIL-CORROSION TEST

This test was described by H. J. Young in a paper read by him at a meeting held by the Institution of Petroleum Technologists, October 11, 1927.

The test was devised to give information concern-

Only 1/4 Turn Between Full, Open and Tight Shut



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ing the tendency of oils to corrode when other laboratory tests failed to disclose this information.

The D. O. C. test is performed by means of an apparatus (see Figure 1), whereby warm oil is run continuously over warm steel, white metal, brass, copper or any other metal. The temperature employed by Young was 10°C. below the boiling point of water, but may be any temperature demanded in any particular case.

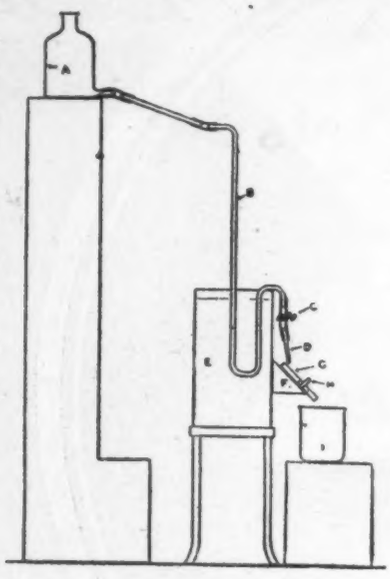


FIGURE 1

D. O. C. Test Apparatus — End Elevation. This apparatus is of sufficient size to carry out five tests at the same time, using one Bunsen burner under the bath. A. Aspirator, 250-1000 *c.c. capacity. B. Glass tubing,* 3/16"—1" *external diameter. C. Screw clip. D. Glass jet. E. Bath,* 4½" x 8" x 18" *long. F. Triangular bar. G. Specimen* 2" x 2" x ¼". *H. Stud. I. Beaker,* 250-1000 *c.c. capacity.*

Young also describes a so-called "sulfate-value" test which he uses in connection with the D. O. C. test. This sulfate-value test is made as follows:

One hundred cubic centimeters of sample is placed in a 600 cc. beaker. To this is added 20 cc. of potassium hydroxide solution (210 grams in 300 cc. of water). The whole is kept at just below 100°C. for three hours with air bubbling through meanwhile. Now is added 90 cc. of hot water. Transfer the mixture to a 500 cc. separating funnel and shake vigorously. When separated, tap off 70 cc. of the alkaline solution into a 200 cc. beaker, acidify with 20 cc. of strong hydrochloric acid, filter and treat with barium chloride solution in the usual manner. (BaSO-4x0. 411=SO4).

Young found that a sulfate value of more than 0.05 per cent. is an indication that an oil is dangerous to use. Also, that corrosive powers are active down to as little as 0.012 per cent. sulfate value.

Young further states that by the D. O. C. test, as little as 0.002 per cent. sulfuric acid can be detected, and the test is equally sensitive to minute amounts of sea water, alkalies, sulfates and so on. Incidentally, the alkalies so readily affect white metal that an oil cleaned by alkali will attack white metal even when that oil has been washed three or four times with water.

The D. O. C. test thus affords a means of testing the efficiency of any cleaning process. In this connection, it has led to the perfecting of a simple appliance which, inserted in an oil system, will keep the oil "sweet."

SOFTENING POINT OF PITCH AND ASPHALT

The Kramer-Sarnow method of determining the softening point of bituminous material consists in inserting a plug of it into a small glass tube, placing exactly 5 grams of mercury above the plug and then heating at the rate of 4°F. per minute. The temperature recorded as the softening point is that at which the mercury drops through the plug.

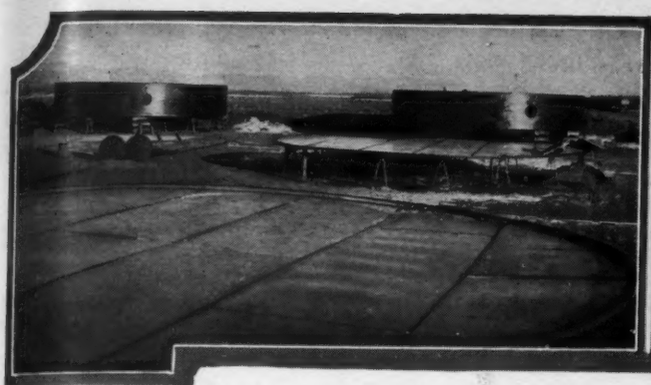
In view of the fact that the exact rate of heating is an important factor in determining softening point by the Kraemer-Sarnow method, heating at the rate of 2°C. per minute giving figures consistently 2° 3°C. higher than heating at the rate of 1°C. per minute, Mallison (Zeitschr. angew. Chem., Aug. 11, 1927) recommends that Klinger's technique of heating at the rate of 1°C. per minute (Chemische Ind. 1914, 220) be adhered to, with this added condition: that the water bath at the start be 20°-25°C. below the temperature at which the softening is expected to occur. This would mean a room temperature for a soft pitch; or about 40°C. for a briquetting pitch.

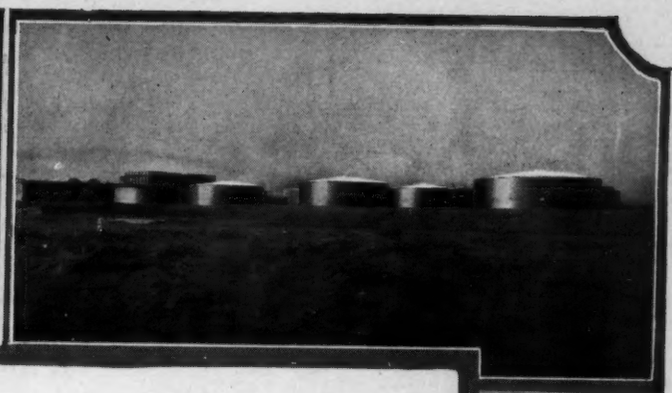
Sulphonation, when used as an index of unsaturated hydrocarbons in oils for insecticidal sprays, is an empirical procedure, in view of the fact that there is no sharp end-point and no advantage is to be to be gained by prolonged heating and shaking. Blackening of certain oils is due to over-heating rather than to carbonization by the acid. Measurement of the unsulphonated residue in cases of excessive blackening is facilitated by the addition, prior to sulphonation, of a measured volume of some other oil of known sulphonation value (for example, kerosene).

Graham (J. Assoc. Off. Agr. Chem., 10, 124 1927) advocates the use of a more suitable method for determining the unsulphonated residue in petroleum spray oils. In the method proposed the oil, after gradual admixture with 38 N -sulphuric acid (the temperature meanwhile being kept below 60°) is heated for 10 minutes at 60° -65°, and shaken for periods of 20 seconds at 2-minute intervals. The unsulphonated residue is then measured after centrifuging for 5 minutes at 1200-1500 revolutions per minute.

DETERMINATION OF SULFUR IN VOLATILE FUELS

Kennedy (Ind. and Eng. Chem., Vol. 20, No. 2, pp. 201-202) describes a newly-devised method for determining sulfur, either elementary or in any form of combination, that occurs in volatile fuels. In this method, the fuel is vaporized in a carbureting device and burned, and the sulfur oxides so produced are absorbed by a sodium carbonate solution of known





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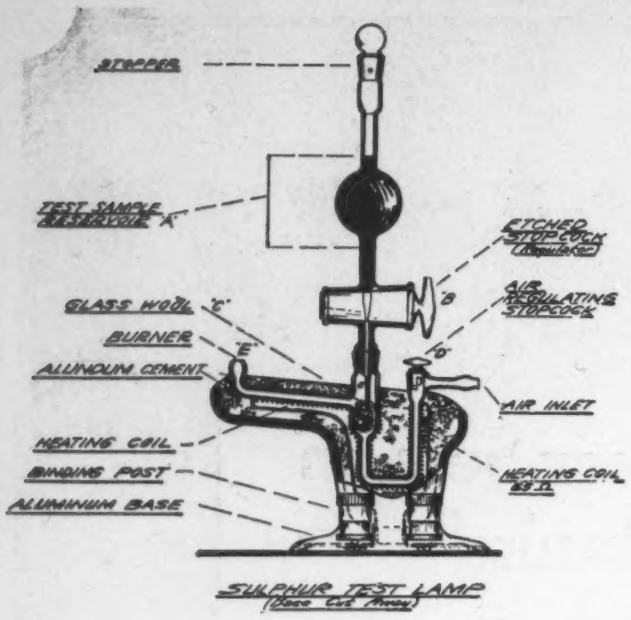

FIGURE 2
Kennedy's Apparatus for Determining Sulphur in Volatile Oils

concentration. The method is said to be precise and rapid. The average time consumed for making one run is 45 minutes.

Figure 2 shows the essential parts of the apparatus required. The fuel being tested is contained in and measured by the reservoir A, from which the fuel passes through the special regulator, B. This consists of an unbored stopcock, on the cylinderical surface of which is etched a tapering channel. By turning this cock, a channel of varying average width is available to conduct the fuel from the reservoir to the vaporizing chamber. Since this stopcock can be utilized through an angle of nearly 90°, the device affords a delicate and convenient means of adjusting the small flow necessary to maintain a flame. The fuel then flows on a small plug of glass wool, C, from which it is vaporized by a current of hot air passing through the air regulator, D, and the mixture is burned at the tip, E. The air regulator, D, consists of a cock, the lower edge of which is ground off spirally. Its position relative to its seat determines the length of a narrow slit which is available for the passage of air. The vaporization chamber is surrounded by a nichrome heating coil of 65 ohms resistance, designed to vaporize the fuel completely. The proper temperature is secured when two sulfur lamps are connected in series across a 110-volt line.

To determine sulfur by means of this lamp, the heater is switched on a few minutes before the run is to be started, the reservoir is filled conveniently by means of a pipet somewhat above the upper graduation with the fuel to be tested, the fuel and air regulators are adjusted, and the flame is lighted, preferably with an alcohol flame, since matches contain a large amount of surfur. The flame should be approximately ½-inch (13 millimeters) high and colorless or slightly yellow. When the fuel meniscus reaches the upper graduation, the flame is placed under an absorber, as in A. S. T. M. Method D-90-26T, the suction on which is so adjusted as to accommodate all the products of combustion. No further attention is needed until the meniscus is approaching the lower graduation, when the fuel regulator is so adjusted that the flame is approximately the same height as at the start. This step is necessary to eliminate the effect of a slight lag in vaporization from the glass wool. When the lower mark is reached, the flame is removed from under the absorber, the solution in which is then titrated as in A. S. T. M. Method D-90-26T. For more accurate work it is titrated until its color matches that in a similar absorber in which 10 cc. of standard sodium carbonate, 10 cc. of standard hydrochloric acid, and sufficient methyl orange have been mixed. One cubic centimeter of each solution is equivalent to 1 milligram of sulfur, and the same amount of methyl orange is present in each absorber. Since the volume of sample burned is always 5 cc., the weight burned may be calculated from the specific gravity. For most unblended fuels only a small error is introduced if the figure 3.75 is assumed as the weight burned. The sulfur content may be expressed on a volume basis—i. e., as milligrams per liter, or grains per gallon—without measuring or assuming a value for the specific gravity. As soon as the fuel has completely run out of the reservoir, another run may be started. It is unnecessary to rinse or clean the apparatus.

DETERMINATION OF NITROGEN BASES

McKee and Parker (Ind. and Eng. Chem., Vol. 19, No. 12, pp. 1343-44) state that 25 per cent acetic acid is the best reagent to use for a rapid determination of the nitrogen bases in petroleum distillates. They state that the use of acetic acid gives clearer solutions, dissolves more of the nitrogen compounds, dissolves them more quickly and causes less polymerization than does the use of hydrocloric acid.

The method used by McKee and Parker is essentially that recommended by Dean and Hill for the sulfuric acid test for unsaturates.

Five cc. of the oil are pipetted into the test bottle and 10 cc. or 200 per cent by volume, of acetic acid carefully added. The bottle is then stoppered, the mixture shaken, diluted with water and immediately centrifuged. Acid of the same strength (25 per cent) is next added to bring the reading within the range of the graduations. The tightly-stoppered bottle is now placed in the centrifuge and whirled at about 1000 revolutions per minute for two or three minutes. The percentage of nitrogen compounds is then calculated from the amount absorbed as read from the graduated neck of the bottle. Each graduation represents 2 per cent by volume, if it be assumed that the volume of the neck between 0 and 25 is 5 cc.

DETERMINATION OF CARBON AND HYDROGEN

The usual method of determining carbon and hydrogen by combustion and absorption of the carbon dioxide and water is tedious and requires considerable skill and experience to yield reliable results.

Whitaker states (Fuel in Science and Practice, February (1928) that a somewhat easier and quicker

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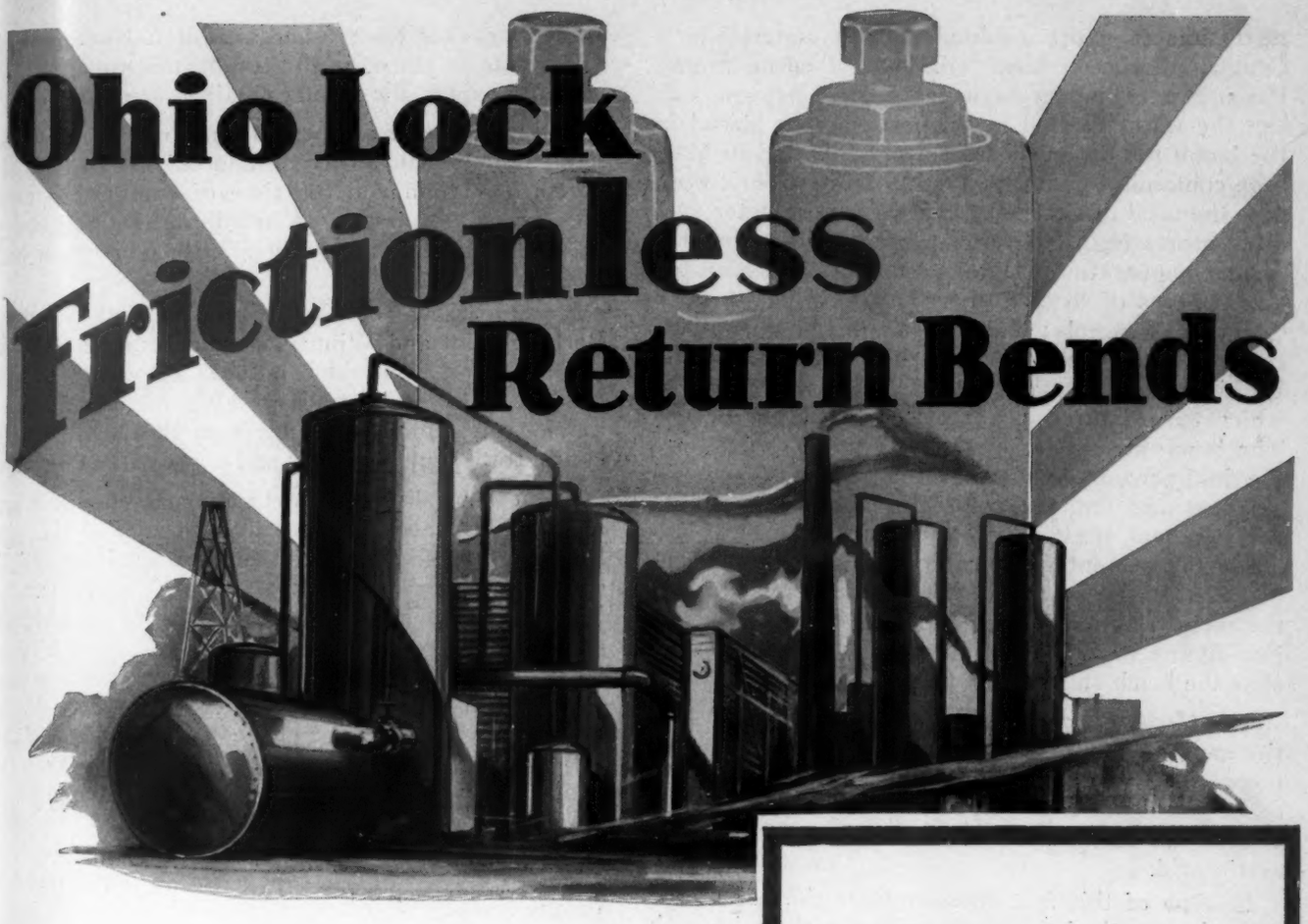

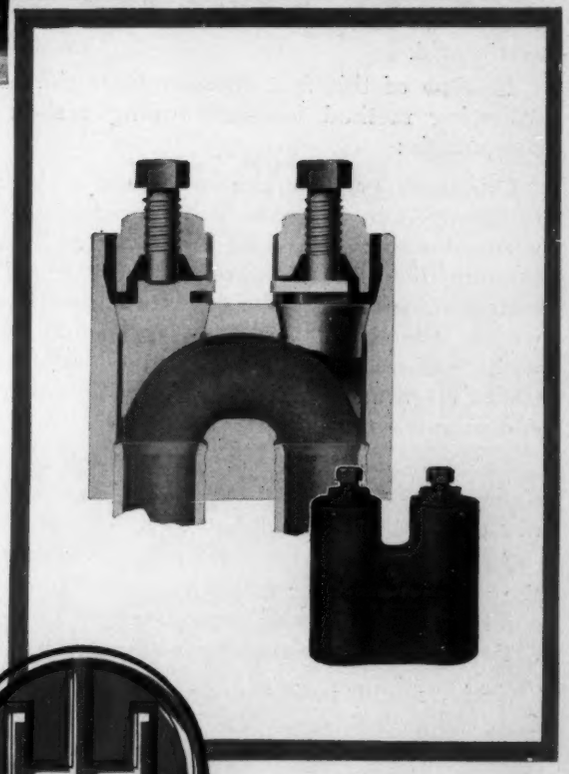

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method is to ignite a sample of the material in a Couthal calorimeter bomb (made by Poulene Freres, Paris, France) under high pressure of oxygen, collect the water formed in calcium chloride placed in the bomb for the purpose in a crucible and in a U-tube containing pumice saturated with sulfuric acid, pass the total discharged gases through a meter and, after measuring, determine the caron dioxide in a Haldane apparatus. Whitaker states that at least ten atmospheres of oxygen should be allowed for each 0.1 gram of sample: that the sample should not exceed 0.3 gram; and that it should be briquetted. Ignition may be made by a short nickel wire to which two or three inches of sewing cotton is tied. The bomb should be so charged with oxygen that the final percentage of carbon dioxide is not over 30 per cent and not under 5. The discharge must be very gradual, occupying one minute. Before calculating the percentage of carbon dioxide, there must be added to the volume of the gases passing through the meter the volume remaining in the calorimeter. For all the water to be absorbed, it is necessary to close the bomb and allow it to stand over night.

Ark (Jour. Chem. Soc., Jan., 1928) has found that the carbon in most aliphatic and aromatic compounds is oxidized almost immediately to carbon dioxide and acetic acid in potassium dichromate solution, if the compound can be dissolved in water or acetic acid.

In view of this fact Ark proposes the use of the following method for determining carbon in such compounds:

One-tenth gram of the compound to be analyzed is dissolved in 15 cc. of water or acetic acid, after which this solution is added to 10 cc. of 2-normal potassium dichromate solution and 33 cc. of concentrated sulfuric acid. The mixture is then poured into water. Thereafter, the excess dichromate is titrated with half-normal ferrous sulfate solution. The CH3.CH-group, when present with other carbon compounds, is oxidized to acetic acid.

This method of analysis is not applicable to aldehydes, succinic acid, substances containing halogens, nor to those containing the imino-group.

Ark states that the "dichromate value" signifies the number of cubic centimeters of 2-normal potassium dichromate solution required for complete oxidation of one-tenth gram of a substance.

Berl, Schmidt and Winnacker (Ber. d. deut. Chem. Ges., Jan., 1928, p. 83) describe a method for determining carbon and hydrogen in organic substances, wherein lead chromate is used when burning the substance for analysis. Incidentally, the lead chromate if not thoroughly dried at temperatures of 550-600 degrees C. gives off water in the combustion process, making the values obtained too high. The tendency of the nitrogen in the substance for analysis to form high oxides, which are not held back by the lead chromate, is said by the authors probably to depend upon the proportion of carbon to hydrogen in the molecule. If this is more than 4:1, no formation of the higher oxides is observable. However, Berl, Schmidt and Winnacker have found that if a layer of lead superoxide be placed in the combustion tube, to hold back the oxides, the results obtained are satisfactory.

The method is described as semi- micrscopic. The sample of substance may contain only 10 to 15 milligrams of carbon and the time of combustion need not exceed 10 minutes. A whole determination can be made by this method in a little more than half an hour.

The apparatus used in the procedure proposed by Berl, Schmidt and Winnacker consists essentially of a soda-lime calcium chloride tube; a combustion tube of Jena glass, 40 centimeters long and 9 millimeter outside diameter; two absorption flasks filled with concentrated sulfuric acid; and a gas volumeter tube.

The carbon dioxide is determined either as a gas or gravimetrically. The combustion zone of the tube lies in a sheet-iron tube, 23 centimeters long and 15 centimeters in diameter, covered with asbestos. To insure uniform heating, a roof of asbestos paper 20 centimeters long is also placed over the tube. A tubular air-bath is connected behind the combustion tube and is held at a temperature of 180 degrees C. by means of a micro-burner placed beneath. When the tubes are filled, 2.5 centimeters of lead chromate project into the 180-degree zone. At this point halogen and sulfur compounds, if formed, are held back. This leaves the lead superoxide lying back of this, and entirely in the cool zone, for the absorption of the oxides of nitrogen exclusively. For substances consisting only of carbon, hydrogen and oxygen, of course this air bath is unnecessary.

When the material for analysis is a volatile liquid, the sample must be weighed and sealed in a capillary tube.

SULFUR DERIVATIVES OF HYDROCARBONS IN PETROLEUM

Faragher, Morrell and Monroe (Ind. and Eng. Chem., Vol. 19, No. 11, pp. 1281-84) give a procedure for the quantative determination of sulfur present in naphtha as hydrogen sulfide, elementary sulfur, mercaptans, sulfides, di-sulfides and, by difference, residual sulfur.

Hydrogen sulfide is determined by shaking the sample with metallic mercury and filtering off the mercury sulfide formed. A lamp determination before and another after the treatment with mercury will give by difference the percentage of *elementary sulfur.*

Mercaptans may be determined by one of two methods: (1) The sample is dissolved in benzol after removing sulfur and hydrogen sulfide and is shaken with alcoholic plumbite. The lead mercaptides formed are dissolved in the alcohol and a lamp determination upon the oil will give by difference the sulfur in mercaptans. (2) The oil freed from hydrogen sulfide and sulfur is treated with a suspension of basic lead acetate and the lead acetate sludge is drawn off. The oil layer is shaken up with a known quantity of 0.1 N sulfuric acid. The lead sulfate is filtered off, the excess acid is titrated with standard alkali, and the mercaptan sulfur equivalent

For their

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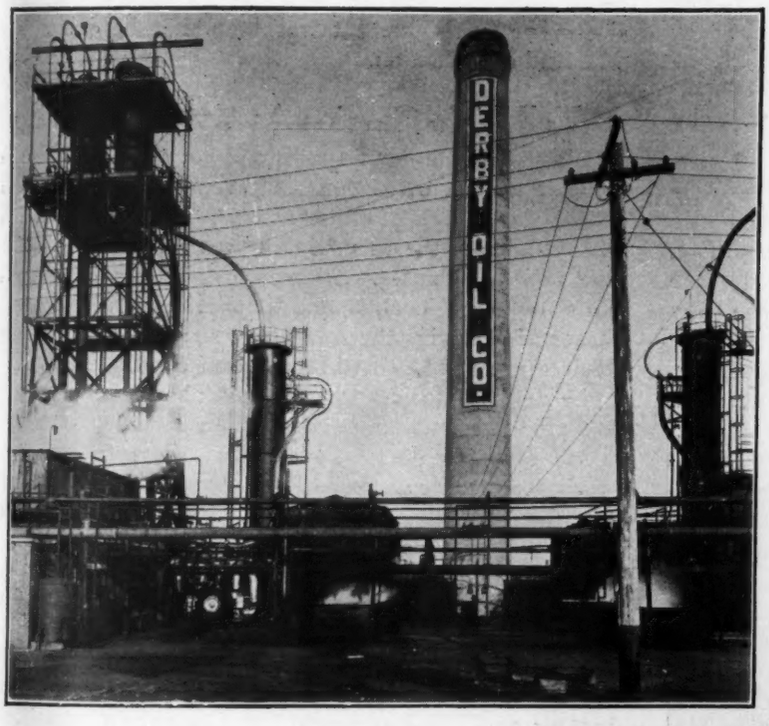

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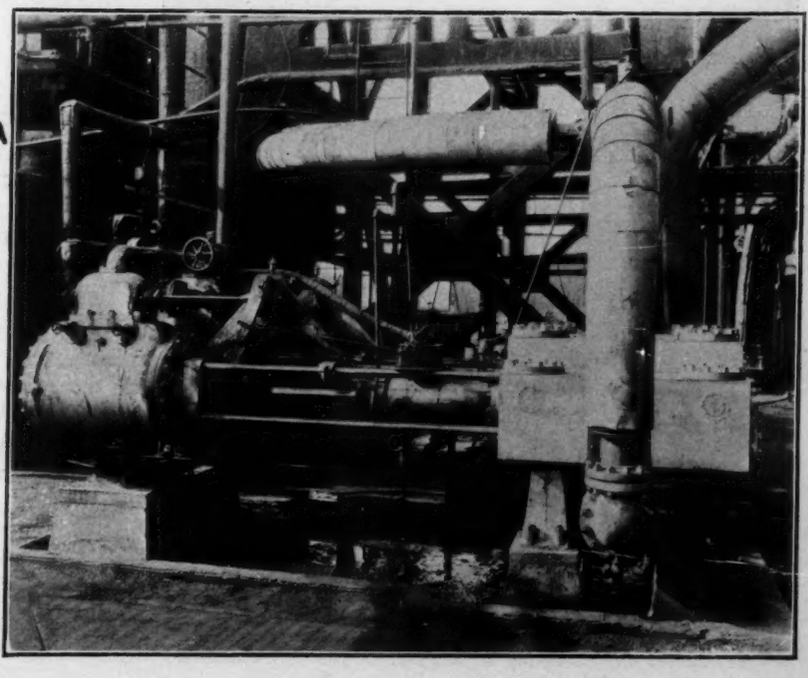

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to the acid consumed is calculated. Aliquot portions are used in both these methods.

In determining *di-sulfides,* the oil freed from hydrogen sulfide and sulfur is first refluxed with dilute (about 10 per cent) hydrochloric or sulfuric acid solution and zinc. Glacial acetic acid, which is soluble in the oil, may be substituted. The disulfides are reduced to mercaptans. The oil is then treated with alcoholic sodium plumbite in order to remove the mercaptans that have been formed. A lamp determination gives the sulfide and residual sulfur in the reduced oil. The sulfur in disulfides is found by subtracting the mercaptan sulfur previously determined from the combined disulfide and mercaptan sulfur. The use of the titration method at this stage gives unexplained results: the percentage of mercaptans found must be multiplied by 3/2 in order to obtain the correct result. Hence it is advised that the extraction with alcoholic plumbite be used.

The oil at this point is treated with mercurous nitrate, which removes the sulfides. A lamp determination gives the sulfur in residual sulfur. The *sulfide sulfur* is found by difference.

DETERMINATION OF KETONES IN DISTILLATES

The determination of ketones in petroleum oils presents great difficulties. The sodium-bisulfite, sulfuric-acid, water-extraction, phenyl-hydrazine methods all either give uncertain results or else they are applicable only to certain ketones.

Stadnikov and Proskournina (Trans, Karpov. Inst. Chem., Sept. 1, 1925, p. 191; Chim. et. ind., Sept., 1927, p. 415) propose the use of the acetylation method for determining the ketones in oils at the boiling point. This consists in determining the number of acetyl groups in the oil both before and after reduction by hydrogen. The authors' results show that the method is good in the case of primary alcohols; but that with cyclic secondary alcohols it furnishes false results varying irregularly with temperatures, period of heating and the proportion of alcohol to acetic anhydride. It is the same for the ketones dissolved in the distillates of high petroleum fractions and of other oils.

Scrap Fittings stop waste from tell-tale on stills of Transcontinental Oil Company refinery at Boynton, Oklahoma

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After a year in the mining industry in Colorado, R. R. Owen is again engaged in the natural gasoline industry. His return came with his connection with the Forrest E. Gilmore Company, whose headquarters are in Tulsa. The concern has gasoline plants operating and building in both Texas and Oklahoma.

Before his mining work, Mr. Owen was superintendent of the natural gasoline department of the Marland Oil Company. He came to the Mid-Continent as a representative of the Hope Engineering and Supply Company, which he left to engage in the carbon black industry in Louisiana. It was then that he joined the Marland organization.

Tell-Tale Carries Away Waste Oil

Dirty oil spots behind stills are not only offensive in appearance but often constitute real fire hazards. Oil soaked earth back of stills has been known to flash, and always adds to the fury of still fires when flashes occur due to other causes. Stillmen, when inspecting shell stills for liquid level, should be provided with adequate means of removing the waste oil when it "shows." Many devices are employed to reduce and eliminate this hazard. Refiners caring for neatness about the plant are willing to spend more money than others toward the reduction of the danger; others are content to use gauge glasses, which are a hazard in themselves, or to permit waste oil to blow from the still at inspection time, thus adding to the danger.

The accompanying photograph shows a commendable tell-tale device, which, though perhaps more expensive in its assembly than some types, is conducive to cleanliness and tends to eliminate fire hazard. This type of tell-tale has been in service for several years on the still battery of Transcontinental Oil Company's refinery at Boynton, Oklahoma, and the absence of black oil spots back of the still is evidence of its efficacy.

Two one-inch lines, one at the top and one at the bottom of the shell still lead into a one-inch header line. The line is tapped at intervals and sturdy faucet type pet cocks screwed into the pipe. Valves are provided between the still and the header line, by which means the tell-tale may be entirely cut off from the still whenever it is necessary to clean, repair, or change a pet-cock. Pet-cocks are frequently inspected and not permitted to leak. However, when leaks occur, or when oil "shows" at the time of still level inspection, the drippings fall into the drain cups as shown in the picture.

The two-inch line supporting the drain cup is open at the top. It conducts oil removed from the still away from the battery through the sewer line and to the trap, where it is recovered.

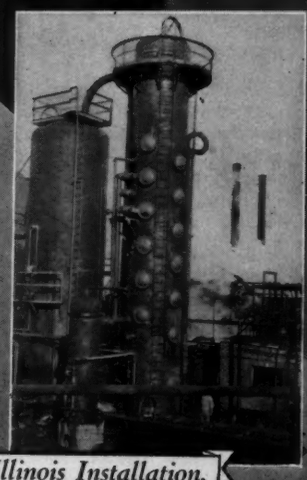
The expense of fabrication of such a tell-tale was materially reduced through the use of old piping, nipples, els, and tees found about the plant yard and assembled by the plant welder. When such devices are rescued from the junk pile the cost can hardly be considered.

A New Louisiana Project.

Going up in Oklahoma.

For Oklahoma Crude.

Under Construction in Texas,



An Illinois Installation.

For several years the WINKLER-KOCH ENGINEERING COMPANY has done a big majority of all the refinery engineering work in the Mid-Continent Field—the most competitive field in America. This is one proof that this Company of highly specialized and competent engineers, devoting their entire time to the refinery industry, can help *you* with *your* problems. Specialists for over four years in remodeling and revamping existing distillation and fractionation equipment, planning and erecting complete new tube still units for various duties, gasoline recovery systems, or complete refineries. Whatever your problems may be, a wire or letter will bring full information about this service to you—without obligation of course.

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WICHITA, KANSAS

Natural Gasoline Association Names Standing Committees for the Year

TULSA, Okla.—Standing committees of the Natural Gasoline Association have been named by Dr. E. R. Lederer, the president. The naming of committees follows the annual meeting in May and the committees serve until selections are made the following year.

The personnel of the committee is as follows:

Executive Committee

E. R. Lederer, chairman, Texas Pacific Coal & Oil Company, Fort Worth; A. J. Schlosser, vice-chairman, Barnsdall Oil Company, Tulsa; H. B. Bernard, Sinclair Oil & Gas Company, Tulsa; D. E. Buchanan, Tulsa; Emby Kaye, Skelly Oil Company, Tulsa; E. L. Peck, Empire Oil & Refining Company, Bartlesville; F. E. Rice, Phillips Petroleum Company, Bartlesville; S. S. Smith, Shell Petroleum Company, Tulsa.

Finance Committee

Emby Kaye, chairman; E. L. Peck, vice-chairman, Empire Oil & Refining Company, Bartlesville; H. B. Bernard, Sinclair Oil & Gas Company, Tulsa; F. E. Rice; S. S. Smith, Shell Petroleum Corporation, Tulsa.

Educational Committee

D. E. Buchanan, chairman, Tulsa; G. G. Oberfell, vice-chairman, Phillips Petroleum Company, Bartlesville; H. B. Bernard, Sinclair Oil & Gas Company, Tulsa; E. R. Filley, The Texas Company, Tulsa; Emby Kaye, Skelly Oil Company, Tulsa;; W. A. Melton, Shaffer Oil & Refining Company, Tulsa; W. W. Robinson, Jr., The Texas Company, Long Beach, California; S. S. Smith, Shell Petroleum Corporation, Tulsa; E. L. Peck, Empire Gasoline Company, Bartlesville.

Gas Contract Committee

T. R. Goebel, chairman, Skelly Oil Company, Tulsa; J. H. Boyle, vice-chairman, Chestnut & Smith Corporation, Tulsa; J. W. Cowles, Shell Petroleum Corporation, Tulsa; R. B. Daughtery, Barnsdall Oil Company, Tulsa; S. J. Fraser, Prairie Oil & Gas Company, Independence M. T. Kirk, Phillips Petroleum Company, Bartlesville; Harry A. Mentzell, Amerada Petroleum Corporation, Tulsa; R. H. McCalley, Forrest E. Gilmore Company, Tulsa; E. L. Peck; C. L. Pitcher, The Texas Company, Tulsa; A. T. Scherer, Sinclair Oil & Gas Company, Tulsa; D. C. Williams, Marland Oil Company, Ponca City; J. R. Freeman, Carter Oil Company, Tulsa.

Gas Testing Committee

Geo. P. Bunn, chairman, Phillips Petroleum Company, Bartlesville; Norris Plank, vice-chairman, Shell Petroleum Corporation, Tulsa; C. L. Baker, The Texas Company, Tulsa; J. E. Dale, Barnsdall Oil Company, Tulsa; H. T. Griffin, Jr., The Palmer Corporation, Shreveport; D. B. Hiatt, Texas Pacific Coal & Oil Company, Fort Worth; J. E. Jones, Marland Oil Company, Ponca City; E. C. LeFevre, Empire Oil & Refining Company, Bartlesville; P. S. Magruder, General Petroleum Corporation, Los Angeles; L. G. Rheinberger, Sinclair Oil & Gas Company, Tulsa; E. F. Schmidt, Lone Star Gas Company, Dallas; E. H. Schoenfeldt, Prairie Oil & Gas Company, Independence; G. L. Shaner, Carter Oil Company, Tulsa; J. M. Yaiden, Skelly Oil Company, Tulsa.

Legal Committee

R. H. Hudson, chairman, Phillips Petroleum Company, Bartlesville; W. M. Z. German, vice-chairman, Skelly Oil Company, Tulsa; Thomas Casey, Barnsdall Oil Company, Tulsa; Karl F. Griffith, Lone Star Gas Company, Dallas; John Hancock, Texas Pacific Coal & Oil Company, Fort Worth; Warren T. Spies, Empire Oil & Refining Company, Bartlesville.

Membership Committee

H. B. Bernard, chairman, Sinclair Oil & Gas Company, Tulsa; A. J. Schlosser, vice-chairman; D. E. Buchanan; F. L. Chase, Lone Star Gas Company, Dallas; M. E. Foster, Phillips Petroleum Company, Bartlesville; E. L. Peck; Geo. L. Ratcliffe, Los Angeles; S. S. Smith, Shell Petroleum Corporation, Tulsa.

Meters and Regulators Committee

Don A. Sillers, chairman, Lone Star Gas Company, Dallas; Geo. Griner, vice-chairman, Phillips Petroleum Company, Bartlesville; P. M. Childers, Marland Refining Company, Ponca City; J. E. Dale, Barnsdall Oil Company, Tulsa; J. J. Delaney, General Petroleum Company, Los Angeles; J. L. Griffin, Skelly Oil Company, Tulsa; C. C. Kelley, The Texas Company, Tulsa; Norris Plank, Shell Petroleum Corporation, Tulsa; James Porter, Jr., Empire Gasoline Company, Bartlesville; R. I. Short, Prairie Oil & Gas Company, Tulsa.

Outage Committee

Emby Kaye, chairman; M. E. Foster; J. E. Jones; E. L. Stauffacher, Empire Oil & Refining Company, Bartlesville; J. R. Freeman; F. E. Burke, Chestnut & Smith Corporation, Tulsa; F. B. Mack, Shell Petroleum Corporation, Tulsa.

Plant Operators' Meeings Committee

G. M. Davidson, chairman for Oklahoma and Kansas, Empire Oil & Refining Company, Bartlesville; F. G. Yonker, chairman for Texas, Chestnut & Smith Corporation, Ranger; J. E. Dale; H. M. Coulson, Sinclair Oil & Gas Company, Tulsa; A. E. Perry, Carter Oil Company, Seminole; D. B. Hiatt, (Texas only), Texas Pacific Coal & Oil Company, Fort Worth; F. E. Shryock, (Texas only), Shell Petroleum Company, Tulsa; Emby Kaye.

Sales Managers' Committee

M. E. Foster, chairman; A. F. Wood, vice-chairman, Chestnut & Smith Corporation, Tulsa; F. D. Bostaph, Texas Pacific Coal & Oil Company, Fort Worth; S. B. Crooks, Empire Oil & Refining Company, Bartlesville; J. C. Evans, Barnsdall Oil Company, Tulsa; F. C. Hall, The Henderson Company, Tulsa; O. B. Lloyd, Marland Oil Company, Ponca City; J. A. LaFortune, Warren Petroleum Company, Tulsa; R. McCalley, Forrest E. Gilmore Company, Tulsa; J. F. Nagle, Skelly Oil Company, Tulsa; A. T. Scherer.

Specifications Committee

S. S. Smith, chairman; S. B. Crooks, Empire Gasoline Company, Bartlesville; Geo. P. Bunn; H. W. Harts, Amerada Petroleum Corporation, Tulsa; Roscoe Howard, Marland Oil Company, Ponca City; P. S. Magruder; J. M. Yaiden, A. T. Scherer; A. J. Schlosser; F. R. Staley, Texas Pacific Coal & Oil Company, Fort Worth; A. F. Wood, Chestnut & Smith Corporation, Tulsa.

Tank Car Committee

Walter Grubb, chairman, Barnsdall Oil Company, Tulsa; A. C. Holmes, vice-chairman, Empire Oil & Refining Company, Tulsa; J. C. Carothers, Chestnut & Smith Corporation, Tulsa; L. E. Frazier, Phillips Petroleum Company, Bartlesville; P. S. Magruder; W. K. Warren, Warren Petroleum Company, Tulsa.

Technical Committee

W. A. Melton, chairman, Shaffer Oil & Refining Company, Tulsa; R. C. Alden, vice-chairman, Phillips Petroleum Company, Bartlesville; H. S. Cole, Jr., The Texas Company, Los Angeles; G. M. Davidson, Empire Oil & Refining Company, Bartlesville; H. E. Felt, Warren Petroleum Company, Tulsa; Roscoe Howard; Emby Kaye; W. R. Lentz, Chestnut & Smith Corporation, Tulsa; S. R. Evans, Sinclair Oil & Gas Company, Seminole; H. W. Manley, Barnsdall Oil Company, Tulsa; Geo. L. Shaner, Carter Oil Company, Tulsa: S. S. Smith.

Traffic Committee

C. R. Musgrave, chairman, Phillips Petroleum Company, Bartlesville; F. E. Burke, Chestnut & Smith Corporation, Tulsa; S. B. Crooks; J. E. Davis, Lone Star Gas Company, Dallas; A. H. Evans, Akin Gasoline Company, Tulsa; S. J. Payton, Sinclair Oil & Gas Company, Tulsa; E. A. Starr, Texas Pacific Coal & Oil Company, Fort Worth; R. E. Stewart, Barnsdall Oil Company, Tulsa; A. F. Winn, Skelly Oil Company, Tulsa.

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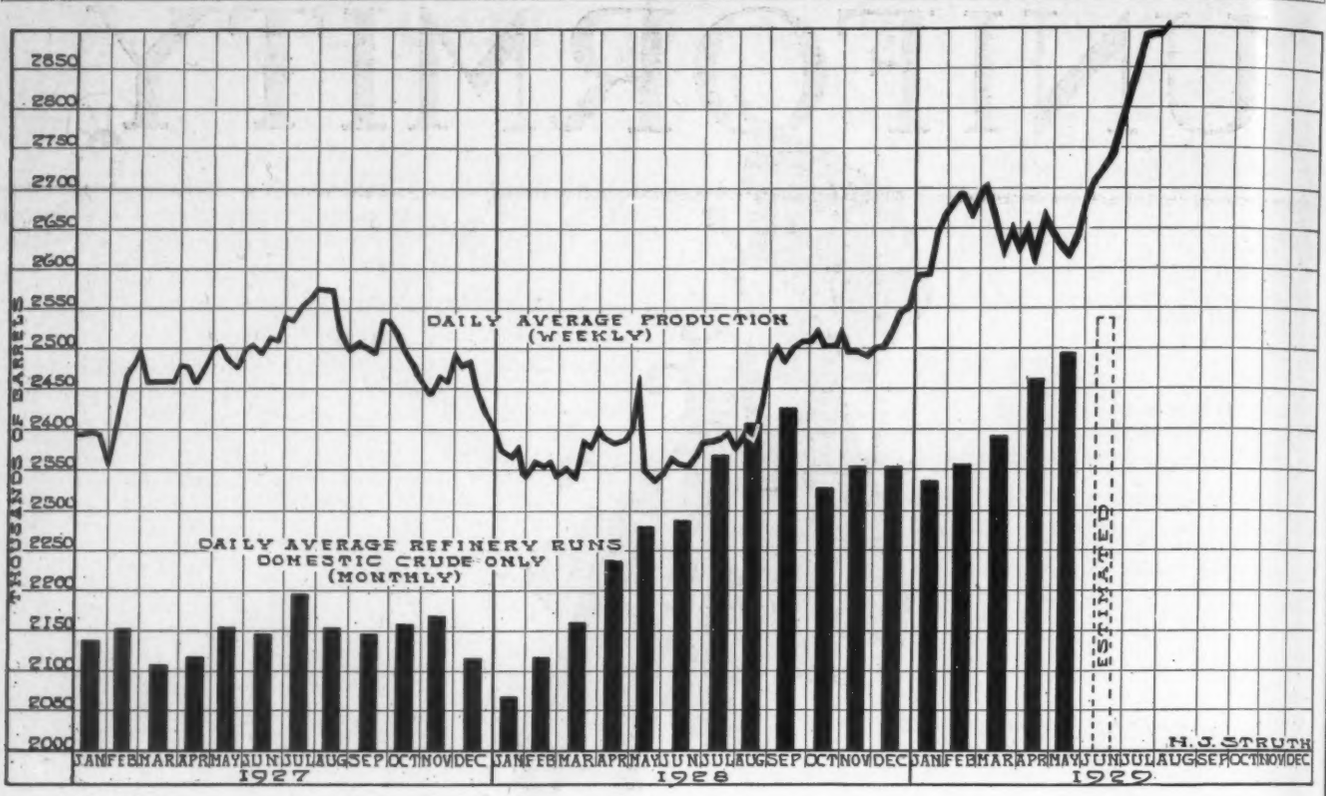
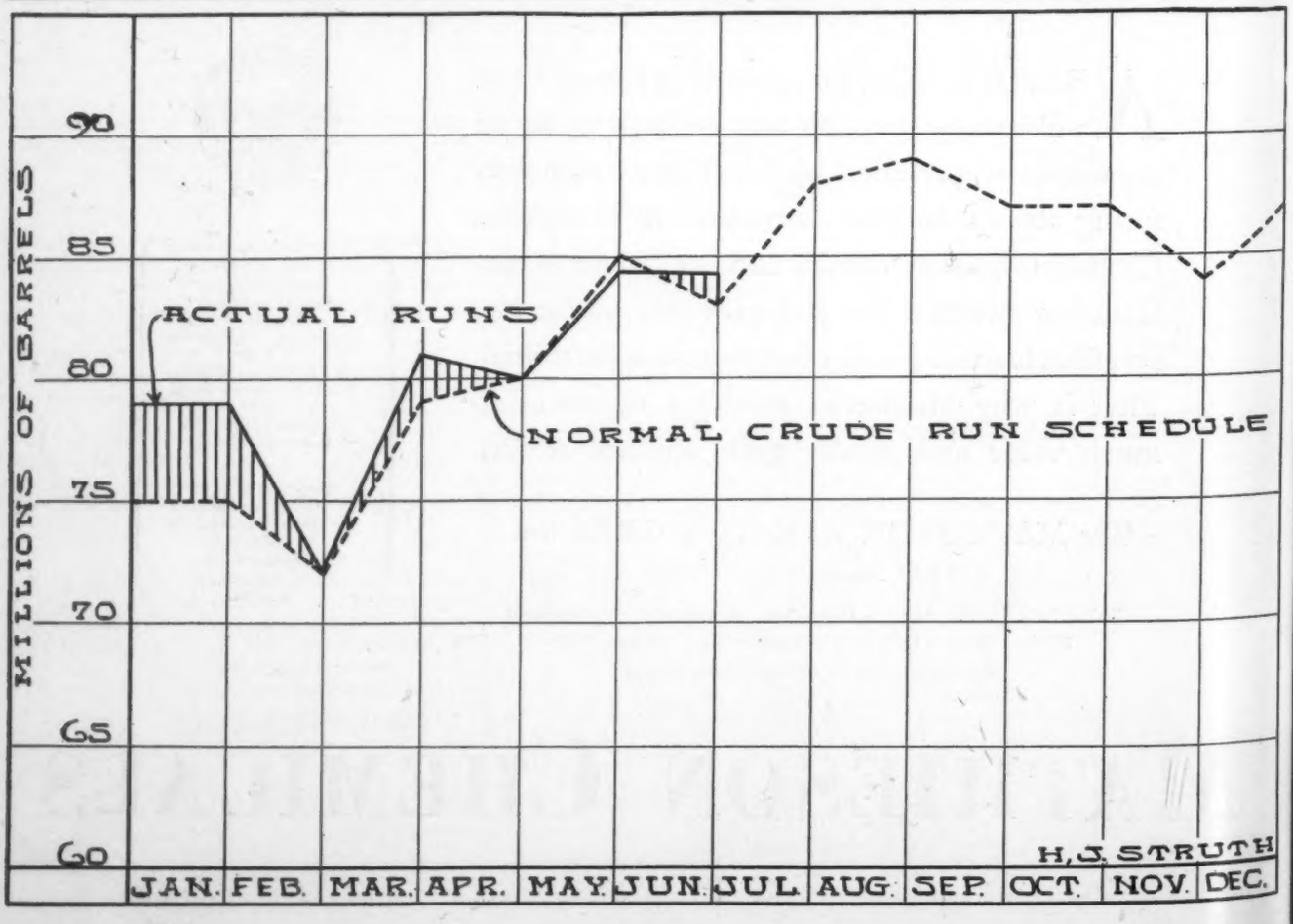
DOMESTIC PRODUCTION AND REFINERY RUNS



REFINERY RUNS OF DOMESTIC AND FOREIGN CRUDE TO STILLS



REFINERY AND GASOLINE PLANT ACTIVITIES

New Plants – Construction Notes – Personnel Changes

WEST TEXAS GASOLINE PLANTS INCREASED

Another natural gasoline plant of the major type is to be erected in the West Texas district, and when completed will boost the average daily production of natural gasoline in the district to more than 100,000 gallons.

Humble Oil & Refining Company started construction work early in July on a 14-unit absorption process plant to operate on sulphur contaminated gas produced in the Yates field, and when completed late this year will have an estimated recovery of 20,000 gallons daily.

Although the Yates field has had heavy gas production for the past two years, plant operators have hesitated on entering this field because of absence of railroad facilities and heavy sulphur content of all gas produced. Humble Oil & Refining Company plans to provide facilities for handling about 25,000,000 cubic feet of gas daily with its initial installation, having selected site on the I. G. Yates lease of The California Company in Section 34. The gasoline production will probably be mixed with crude run from the field by the Humble Pipe Line Company, as more than 25 miles of line would be required to reach a railroad shipping point. The natural gas produced in the Yates field ranges from one-half to two gallons of natural gasoline per 1000 cubic feet, while the average is nearer three-quarters of a gallon recovery. G. L. McCormick is superintending the construction work.

Phillips Petroleum Company maintained a daily average recovery of 49,500 gallons during June from its Crane County plant, which was put in operation last January. This plant is taking gas from the Church & Fields and Gulf-McElroy areas, and a revival of drilling activity lately assures a capacity load of gas for some months ahead. The above company is averaging about 5500 gallons daily from its small plant in the Noodle Creek field, Jones County. The jitney unit plants operated for a period in Mitchell County by The California Company, Magnolia Petroleum Company and Atlantic Oil Producing Company have been abandoned.

In the Big Lake field, the Signal Gasoline Company of Texas is recovering about 21,000 gallons daily from its absorption plant that is deriving most of its gas from the deepest oil and gas producer in the world. This particular producer is known as Group One Oil Corporation's University 1-B, and is flowing about 2700 barrels of 56 degree gravity oil and about 25 million cubic feet of gas daily at 8523 feet. However, the unusual high gravity of the oil is not reflected in the gasoline content of the gas, as the latter only averages about .58 of a gallon per 1000 cubic feet of gas stripped, while a recovery of 3.28 gallons per 1000 feet is obtained from about 1,500,000 cubic feet of gas produced in the 3000-foot lime horizon. In this field Big Lake Oil Company has an absorption gasoline plant that is making about 20,000 gallons daily. Magnolia Petroleum Company has a small plant in the Chalk field, Howard County, and is averaging about 750 gallons of natural gasoline daily. This production is blended locally, and marketed in the district.

Natural gasoline plants in operation and building in the West Texas district are listed below:

Company and Location—	Daily Prod. in Gals.
Phillips Petroleum Company, Crane County	49,500
Phillips Petroleum Company, Jones County	5,500
Signal Gasoline Company, Reagan County	21,000
Big Lake Oil Company, Reagan County	20,000
Magnolia Petroleum Company, Howard County	750
Humble Oil & Refining Company, Pecos County	*20,000

*Building.

LOUISIANA GASOLINE PLANT TO BE CONSTRUCTED

Under terms of a recent agreement whereby United Gas Company has sold the gasoline content of its natural gas production in Richland Parish, Louisiana, Louisiana Gas & Fuel Corporation, the latter company, a unit of Electric Bond & Share Company, will gather the gas, extract the gasoline and deliver dry gas to United Gas Company's trunk lines. The gas will then be piped to Atlanta, Georgia, and Arkansas points. Site of gasoline plant to be erected by Louisiana Gas & Fuel Company has not been announced.

Another United Gas Company subsidiary, Dixie Gulf Gas Company, has erected an oil absorption natural gasoline plant at its Waskom compressor station, northeast Texas, which is extracting approximately 50,000 gallons of Grade "AA" gasoline daily, the product being moved under private contract.

GASOLINE PLANT IN JACK COUNTY, TEXAS

Panhandle Refining Company, Wichita Falls, Texas, has completed construction and started operating its six-unit natural gasoline plant in the Bryson field of Jack County, Texas. This is the first gasoline plant in this area. The gas is reported to have a gasoline content of around two gallons per thousand cubic feet. Residue gas is at present recycled through the oil sand.

BUILDING GASOLINE PLANT IN RICHLAND PARISH, LOUISIANA

Columbian Gasoline Corporation will begin construction of a new oil absorption natural gasoline plant in the Richland Parish, Louisiana, gas field at once. The plant will be erected two miles north of Alto. It will be operated at field pressure, 400 pounds, handling 40 million cubic feet of gas daily and recover from 12,000 to 16,000 gallons of gasoline. Residue gas will be discharged into the Richland-Monroe-St. Louis gas pipe line, which is scheduled for completion October 1.

The plant will consist of four Ereco absorbers, and distillation unit of the same type, and a high pressure fractionating column of Ereco design. Heat transfer equipment, exchangers and oil coolers and condensers, will be Griscom-Russell type. Gasoline will be piped to the company's loading rack five miles away, at Archibald, Louisiana. In addition to the plant the company is to build eight modern dwellings for employes and office and laboratory. W. E. Reardon is superintendent of the manufacturing department, with headquarters in Monroe, Louisiana

BUCHANAN LEAVES CHESTNUT & SMTH CORPORATION

D. E. Buchanan resigned as vice president of Chestnut & Smith Corporation, effective August 1, 1929. Buchanan announced that he would take a vacation before announcing future plans. At the same time he resigned as vice president of the Naturaline Company of America, an organization affiliated with Chestnut & Smith interests.

Buchanan was with Chestnut & Smith Corporation for 10 years. He was sales manager for four years before being elected vice president. In this latter capacity he had supervision of sales and also devoted considerable time to manufacturing methods and research.

The Naturaline Company of America was formed to sell an aviation fuel, made from natural gasoline.

Buchanan was the first president of the Natural Gasoline Association of America and served two years. For several years he was the representative of the natural gasoline division of the petroleum industry on the board of directors of the American Petroleum Institute.

RATCLIFFE LEAVES GENERAL PETROLEUM

George L. Ratcliffe, has resigned as manager of the gas department of the General Petroleum Corporation to become president and general manager of the California Talc Company of Los Angeles.

Ratcliffe was president of the California Natural Gasoline Association and vice president of the Natural Gasoline Association of America. He has given notice of his resignation from both these posts.

MIDLAND SELLS INTEREST

Midland Refining Company, which is operating a 2000-barrel daily capacity skimming plant at Midland, Texas, has sold 51 per cent interest to the Cranfill & Reynolds Company of Dallas, but will continue to operate as heretofore under the same management, and possibly the same name. T. W. Sowell, Dallas, is president of the Midland Refining Company, and the plant equipment consists of the first model of the portable refinery patented by the Portable Refining Company, Dallas, Texas. The plant is operating on Winkler County crude being purchased on contract for the next 10 months from a major company.

LONE STAR BUYS ADAMS PLANT

Lone Star Gas Company has purchased the absorption gasoline plant of the Adams Gasoline Company, a subsidiary of the Superior Oil Corporation, Tulsa, and also the Eastland County, Texas, oil and gas producing properties of the Moody Corporation, another subsidiary of the letter organization, for a cash consideration of $300,000. The gasoline plant is located on the Dyer farm, northwestern corner of Eastland County, and is equipped with six units rated at six million cubic feet of gas capacity daily, while the current gasoline recovery is averaging 2800 gallons daily. The new owners are to materially increase the capacity of the Dyer plant to permit stripping of gas from its Brooks, Elliott and Henry leases across the line in southwestern Stephens County, while the residue gas will be marketed in the Lone Star Gas Company's gas line, extending westward via Baird, Abilene, Sweetwater to Colorado.

COSDEN TO BUILD

J. S. Cosden, Inc., which is the Oklahoma operating subsidiary of the Cosden Oil Company, is purchasing materials to erect a 30 million cubic foot capacity absorption gasoline plant on its James Gardner lease, Roxana pool. The plant will be located in Section 31-19n-4w, and about three miles from the town of Lovell on the Santa Fe Railroad. The natural gas produced in this area averages 1½ gallons of natural gasoline per 1000 cubic feet. This is the first gasoline plant to be erected by the Cosden interests. Headquarters of the company is located in the Electric Building, Fort Worth, with J. S. Cosden, president, actively in charge.

RECEIVERSHIP GRANTED

The Pecos Valley Refining Company, which has been operating a 7000-barrel daily capacity skimming plant on Winkler County crude at Pyote, Texas, lost its crude contract with the Texon Oil & Land Company on July 29, and was placed in the hands of a receiver here on July 30. W. M. Harrison, president of the Star Refining & Producing Company, Fort Worth, was designated receiver, and he immediately started liquidating a heavy stock of fuel oil and gasoline in storage at Pyote. Eugene Griswold is president of the Pecos Valley Refining Company. The plant had been operated continuously since February 23, 1928.

N. P. A. AT ATLANTIC CITY SEPT. 18, 19, 20

National Petroleum Association will hold its annual fall meeting at Atlantic City, September 18, 19, 20. Convention headquarters this year, as in the past, will be at Hotel Traymore. Members and visitors expecting to be present are urged to make their hotel reservations early. O. P. Keeney, Keeney Oil Company, New York, advises that an interesting and valuable program is being arranged for the three day session.

HUMBLE OIL & REFINING COMPANY HYDROGENATION PLANT

Following the announcement of completion of experimentation at Baton Rouge, Louisiana, with a semi-commercial unit of the hydrogenation process and the proposed erection of a large hydrogenation plant by Standard Oil Company of New Jersey, comes news of a similar plant at the Baytown, Texas, refinery of Humble Oil & Refining Company. The plant at Baytown will involve an expenditure of about $2,500,000. It is reported that both the New Jersey Company and the Humble Oil & Refining Company's units will have a rated capacity of 5000 barrels daily. The New Jersey installation is to be completed and placed in operation by the end of the year.

Standard Oil Company of New Jersey states that upon completion of present work, it will be in a position to liscense the process to other refiners in this country and all foreign countries excepting Germany, where I. G. Farbenindustrie will exploit the process. The hydrogenation process is expected to supplement present day liquid and vapor phase cracking processes rather than supplant them.

Cost figures are not yet available. The process, however, is reported to secure a gallon of gasoline for every gallon of charging stock charged to the unit. It is a catalytic process operating at high pressure, introducing hydrogen under pressures upward of 100 to 300 atmospheres and employing temperatures within the range at present used in cracking operations. The hydrogenation process prevents the formation of coke, reduces gas formation and is practically continuous in operation.

TWO OKLAHOMA GASOLINE PLANTS BEING ERECTED

Sinclair Oil & Gas Company is constructing two natural gasoline plants in different sections of Oklahoma. The larger installation is in the Oklahoma City field in Section 30-11-2w, where the company has two producing wells at this time, one of which is producing around 50,000 gallons of 70 gravity gasoline along with a large natural gas production. This plant will have a rated capacity of 50,000 gallons and is of the absorption type.

The second plant will be a combination type having 16 units in the compression department. The location is given as Section 7-6-8 in the Sasakwa district, between Wewoka and Allen. Estimated cost is $75,000.

PHILLIPS STABILIZING PLANT BUILDING AT HOUSTON

Phillips Petroleum Company has construction of its high pressure stabilizing plant well under way at Houston. J. K. Gibson, construction engineer is in charge of the work.

In addition to the Tulsa-Type high pressure fractionating unit the company is erecting one 80,000-barrel storage tank, one 25,000-barrel steel storage tank, two 10,000-barrel Horton spheroid tanks and a number of smaller tanks for storage of the stable finished product. The report that Phillips Petroleum Company planned the erection of a refinery at this point was denied. Sufficient acreage is included in the site purchased to permit the building of a refinery, if such a course should be decided upon in the future.

Gasoline to be treated or rectified at this plant will be shipped in by tank car. A 30-car rack has been designed for this purpose. Shipment will be by rail and water, utilizing the Crown Central wharfs for the water shipping for the time being.

Contract for erection of the larger storage tanks was awarded to Chicago Bridge and Iron Works.

GASOLINE PLANT AT MANGUM

International Gas Products Company, Monroe, Louisiana, has given contract for the erection of its new natural gasoline plant to the Stearns-Roger Manufacturing Company of Denver. The plant is being erected near Mangham, just south of production in the Richfield Parish gas field. The plant is being built under the supervision of the J. A. Campbell Company of Long Beach, California, and is designed to handle 30 million cubic feet of gas daily at a pressure of 200 pounds. Residue gas will be consumed by International Gas Products Company's carbon black plant.

Natural gas pressure will be utilized in the operation of pumps on the plant yard so long as field pressure is sufficiently high to permit of such practice. This involves installation of a piping system which will permit either gas or steam to be used.

STANDARD OF PENNSYLVANIA BUYS SITE AT PITTSBURGH

The Standard Oil Company of Pennsylvania, a subsidiary company of the Standard Oil Company of New Jersey, has purchased a site of about 15 acres at Pittsburgh, where it will erect a bulk plant for storage and distribution of gasoline, oils and greases. The site is bounded by the Allegheny River, the Allegheny Valley Railroad, Thirty-third and Thirty-fifth Streets.

GASOLINE PLANT ON GAS LINE

Independent Natural Gas Company, which is owned by the Independent Oil & Gas Company, Tulsa, has started construction of an oil absorption natural gasoline plant at Wewoka, Oklahoma. The plant is located on a gas line owned by the Independent Natural Gas Company, also a subsidiary of Independent Oil & Gas Company. Capacity is rated at 4000 gallons.

360° of Wearing Surface

THE claims of "long life" made for Darling Valves do not consist of idle chatter. They are based on definite, tangible elements of construction which any cautious buyer can see and touch. Take the parallel discs for example. These revolve every time the valve is operated, seating at a different place with each occasion. Surely this feature contributes appreciably to the life of a valve.

Other desirable features are renewable seats with ground-in faces. A wedging mechanism that carries discs over port and in front of seats before spreading. The largest Darling Gate Valve can be easily operated by one man without artificial aid.

Catalogues and diagrams on request

DARLING VALVE & MFG. CO.

Williamsport, Pa.

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DARLING

GATE VALVES

SEMINOLE GASOLINE OUTPUT

Natural gasoline production by 17 operators in the Greater Seminole area, Oklahoma, is holding its own over the past two months at approximately one million gallons daily. Sinclair Oil & Gas Company is the largest gasoline manufacturer in the area with an average production close to a quarter of a million gallons daily. Carter Oil Company is the second largest producer of gasoline in the Seminole region and Gypsy Oil Company is the third. Scout reports from the area show the following production by companies:

	Gals.
Amerada Petroleum Corporation	43,500
Barnsdall Oil Company	50,000
Carter Oil Company	172,000
Crosbie & Moran	26,000
Empire Oil & Refining Company	91,500
Forrest E. Gilmore Company	68,000
Gilmore Production Company	3,200
Gypsy Oil Company	132,000
Independent Oil & Gas Company	45,000
Magnolia Petroleum Company	18,000
Moran & Gillespie	22,000
Pure Oil Company	42,000
M. F. Powers	15,000
Shell Petroleum Corporation	78,000
Sinclair Oil & Gas Company	249,000
Skelly Oil Company	35,500
Victor Gasoline Company	65,900
Total, 17 companies	1,156,600

PHILLIPS PETROLEUM COMPANY ENLARGING REFINERY

Phillips Petroleum Company is enlarging capacity of its Borger, Texas, refinery from 10,000 to 15,000 barrels daily through the addition of more tubular retort equipment. Additional water lines, transfer lines, pumps and other auxiliary equipment will be installed to take care of the larger capacity. The company recently completed installation of cracking facilities at this plant. Phillips Petroleum Company announced during July that it would install a 5000-barrel refinery at Wichita, Kansas. M. P. Youker is general superintendent of refineries for the company.

D. B. Kelley, formerly superintendent of refinery operations for the American Refining Company, Wichita Falls, Texas, is now manager of the Lemont, Illinois, refinery of The Globe Oil & Refining Company.

SHAFFER RANCH PLANT OPERATING

Skelly Oil Company began operations at its new Shaffer ranch natural gasoline plant at Kings Mills in the Texas Panhandle area late in July. Initial capacity is reported at 10 to 12 thousand gallons daily. This is the second gasoline plant erected on the Shaffer ranch by the company.

NEW TREATING PLANT

El Dorado Refining Company, El Dorado, Kansas, announces completion of fabrication and erection of its new continuous treating equipment. Kaw Steel Construction Company, Kansas City, furnished equipment and construction was handled by regular company construction force under the direction of plant superintendent G. C. Anderson.

COMMERCIAL ANALYTICAL LABORATORIES AT TULSA

Podbielniak - Raigorodsky, consulting engineers, Philtower Building, Tulsa, announce the opening of their commercial analytical and research laboratories for petroleum products in the Medical Arts Building, Tulsa. The laboratories will specialize in fractional distillation analysis with the improved Podbielniak apparatus, and are also equipped to run a variety of other tests such as the standard absorption and slow combustion tests on gases, and the determination of molecular weight of aborption oils. The specific purpose is to be of service to oil, gasoline and refining companies in the analysis of gas, gasoline and oil samples and to conduct research work on problems submitted.

Manufacture and distribution of the Podbielniak apparatus will be handled through the main office at Tulsa and a branch office in California. A glass-blower is now equipped to construct glass apparatus from sketches and specifications and to do repair work of small kinds. This is the first time such service has been available in the Mid-Continent.

The laboratory and engineering staff is prepared to test gasoline plant performance by making complete plant balances, using fractional distillation analysis, and to give consulting service on all phases of gasoline plant design, construction and operation, and on research problems.

New Merco Nordstrum Plant

CENTRAL TEXAS REFINING INCLUDED IN MERGER

The Cranfill-Reynolds Company, incorporated under the laws of Delaware, has been perfected to operate the merged interests involved in the consolidation of the Cranfill & Reynolds interests, the Central Texas Refining Company, and the oil production holdings of the Moody-Seagraves interest, Houston.

T. E. Cranfill, Dallas, was elected president of the new company. O. R. Seagraves, Houston, Texas, is chairman of the board. W. L. Moody, III, is vice-president and treasurer; J. H. Reynolds, Dallas; A. H. Richardson, Dallas, and Walter L. Goldston are vice-presidents.

The Cody Petroleum Company of Cody, Wyoming, was included in the merger. United Gas Company, a Moody-Seagraves organization formerly controlled 80 per cent. of the Cody Petroleum Company. Other Moody-Seagraves holdings merged into the new company included wildcat acreage in the Gulf Coast area.

Cranfill & Reynolds part of the new company included considerable production in West Texas and gathering lines and property in West Texas and Southeast New Mexico.

Central Texas Refining Company continues as a subsidiary with C. A. Middleton as president. The company has refineries at Corsicana, Minerva, Brownwood and Midland, Texas. United Gas Company also controls Motor Fuel Products Company, operating a refinery at Laredo, Texas.

BILLINGS REFINERIES

The near completion of the Yale Oil Corporation's refinery at Billings, Montana, has given out the information that the production on which this plant will be run is to come from the Oregon Basin field in northwestern Wyoming. This will provide a market for this field such as it has not had previously; the new refinery will handle about 3000 barrels of crude per day.

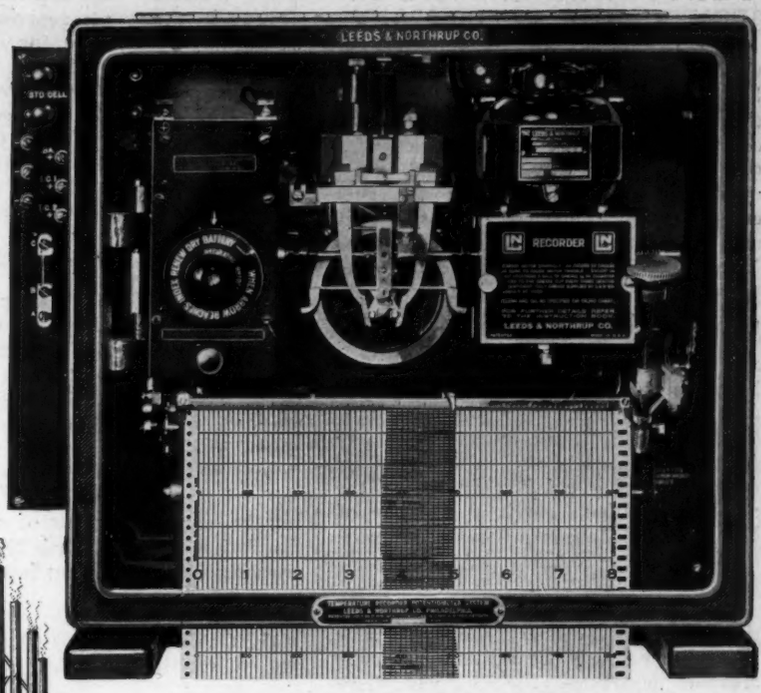
The Texas Company's refinery there will be operating soon, also.

Anderson-Pritchard Oil Corporation, Oklahoma City, Oklahoma, are enlarging capacity of both refineries operated by the company, at Cyril, Oklahoma and Colorado, Texas. The Cyril plant, which is especially designed for preparation of special naphthas, will be enlarged to 5000 barrels capacity. The Texas plant will have a 3000-barrel cracking unit upon completion of present work. Total expenditure reported is estimated at $1,000,000.

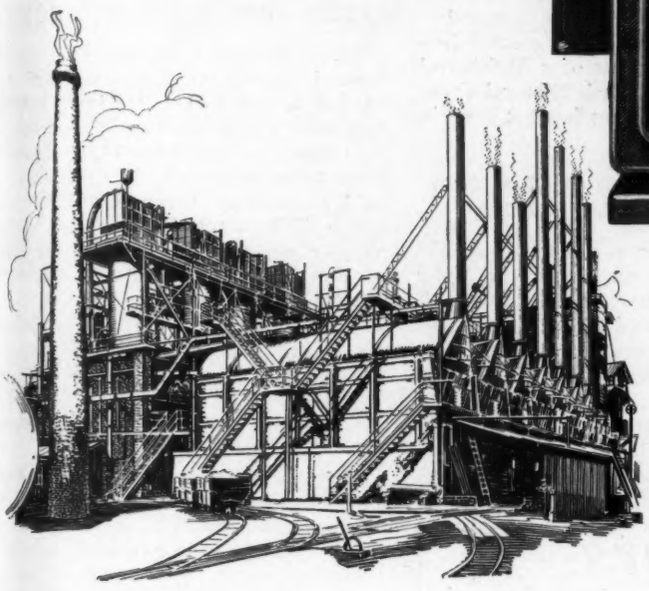
VALVE PLANT EXPANSION

Completion of the enlarged plant of Merco Nordstrum Valve Company in Oakland, California, is announced. It offers practically double the amount of manufacturing space formerly available and also provides special engineering quarters. The company manufactures lubricated plug cock valves for the gas, oil, food, paper and chemical industries.

For Closer Cuts ~ For True Economy



Area drawn by pen shows difference between vapor (at left edge) and oil at still outlet (at right edge)



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WITH CRUDES changing ever so slightly, uniform quality of product cannot be maintained—unless the still operator can keep closely within the temperature limits set by the laboratory. Often the *difference* in temperature between two points in the process is just as important as the temperatures observed separately. The dependable L&N 2-point type of recording is profitable to both operator and management.

Dependability is an outstanding feature of L & N Potentiometers—different pyrometers—the most accurate in industry—especially valuable to the oil refiner.

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PERSONNEL CHANGES IN CONTINENTAL OIL COMPANY

The recent merger of Marland Oil Company and Continental Oil Company has made several changes necessary in the manufacturing departments of the companies, which are now combined with offices at Ponca City, Oklahoma. The manufacturing department of the new company, which takes the name, Continental Oil Company, is headed by Walter Miller, vice-president, who held the same position with the Marland Oil Company.

Mr. Miller has as his assistant, Harold G. Osborn, who has the office of assistant manager of manufacturing. Mr. Osborn has been assistant to Mr. Miller for a number of years.

Ray Russell, formerly chief engineer for the Continental Oil Company has been appointed acting chief engineer for the new organization. He is a graudate of University of Kansas and has been in the employ of the Continental Oil Company for five years.

L. L. Davis, formerly superintendent of the Ponca City refinery has been made supervisor of the process division, a newly created department, which will have charge of process development work, research, and control laboratories. C. F. Tears, formerly assistant to the general manager of refineries for Continental Oil Company, has been appointed assistant to Mr. Davis. R. E. Redfield of the old Continental Oil Company organization is now combustion engineer.

Fred G. Fellows has been promoted from assistant superintendent of the Ponca City refinery to superintendent. M. E. Clawson is assistant superintendent.

W. M. Haynes is resident engineer, C. O. Melberg is assistant resident engineer, and Alfred Henriksen, formerly chief engineer of the Ponca City plant is now chief chemist of the manufacturing division. Joe Boylan is chief fire marshal for the manufacturing division.

OMAHA REFINERY

The Omaha Refining Company plant at East Omaha, Iowa, has been purchased by the MonaMotor Oil Company of Council Bluffs, Iowa. According to an announcement by H. A. Searle, general manager, the refinery is to be remodeled and placed in operation. For the present only the cracking equipment will be operated.

The East Omaha plant was erected during the war and consists of a 2000-barrel distillation unit and one 1000-barrel Cross cracking unit. The plant has not been in operation since 1927.

OHIO STANDARD ENLARGES CRACKING FACILITIES

Standard Oil Company of Ohio recently completed construction of two new Tube & Tank cracking units at its Cleveland, Ohio, plant and placed them in operation. These are high pressure and high temperature units operating at 1500 pounds and about 1000°F. The capacity of the two new units is reported at 2250 barrels each.

Quickly Makes Joints Leakproof!

an entirely new and improved type of graphite sealing paste for screw thread or flange joints, that is

Not Soluble in Hot or Cold Oils

***Expands* instead of shrinking when subjected to high temperatures and permanently remains in the expanded state assuring tight leakless joints for years of service.**

Dixon's Graphite Seal

Write for free test sample and circular 99-DS.

JOSEPH DIXON CRUCIBLE CO.

Jersey City D X N New Jersey

Established 1827

DIXON'S GRAPHITE SEAL

WICHITA FALLS REFINERY CHANGES HANDS

Victory Petroleum Company of Delaware has acquired the Boardman Oil Company's skimming plant, located near Wichita Falls, according to J. E. Force, secretary-treasurer of the former concern, and will resume operations shortly after impovements and additions can be made to the plant. The refinery was originally known as the Sunshine State Refining Company, and is rated at 750 barrels daily, but is to be enlarged. C. B. Ray has been engaged as superintendent. He was formerly in charge of the Burkburnett plant of the LaSalle Petroleum Company, which recently succeeded the Noble Oil & Gas Company.

CITIES SERVICE IN CALIFORNIA

Cities Service Company has recently formed a new subsidiary organization known as the Cities Service Petroleum Company which will operate exclusively in California. In May, 1929, Henry L. Doherty interests opened California offices in 1157 Subway Terminal Building, 416 South Hill Street, Los Angeles. W. L. Walker was transferred from the offices of the Empire Gas & Fuel Company at Bartlesville, Oklahoma. At the same time S. E. Murphy was transfered to California representing the Cities Service Refining Company of Boston and the Crew Levick Company of Philadelphia; and D. A. Deckman was transfered to represent the Empire Gas & Fuel Company.

Previous to this Cities Service Company had not entered the California area except in the marketing of lubricating oil. The present move points to the continuation of the company's program of expanding operations from coast to coast.

CAREY POOL PLANT COMPLETED

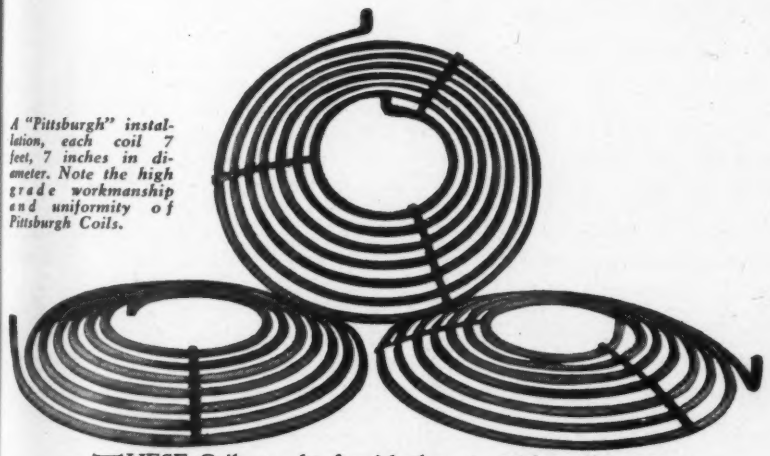
Crosbie, Porter & Martin, Tulsa, have completed construction of their oil absorption natural gasoline plant in the Carey pool, Okfuskee County, Oklahoma, and placed the equipment in operation early in August. The location is given as SE SW 29-12-10. The plant has a rated capacity of 20,000 gallons daily. There are 13 producing wells in the Carey pool at this time, with several more due for early completion. The plant is five miles north of Okemah, Oklahoma.

E. F. O'Bryne who for the past six years has been manager of sales for Lion Oil & Refining Company, El Dorado, Arkansas, has resigned his position effective August 1. O'Bryne is succeeded by W. H. Reed, formerly in charge of the Lion Oil Company of Mississippi with headquarters at Jackson, Mississippi. Reed has been connected with the subsidiary company for about two years and has had a number of years experience in the marketing of petroleum products in the South. His former home was New Orleans, Louisiana.

O'Bryne's future plans have not been announced.

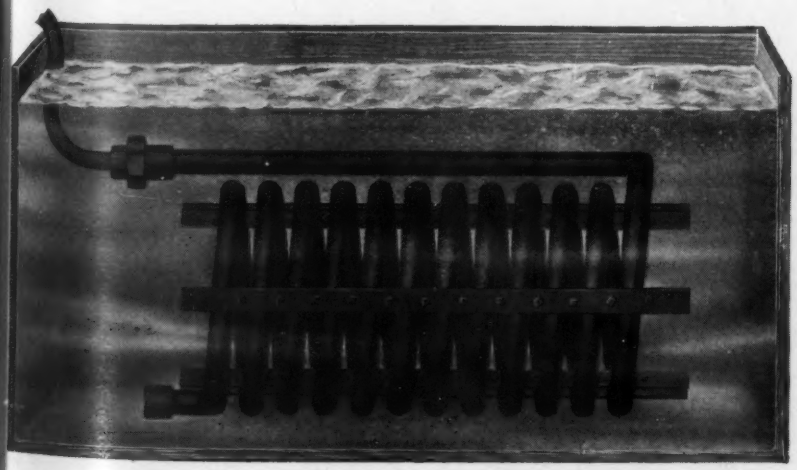
Pittsburgh AIR PRESSURE TESTED Coils

built for oil country and refinery use



A "Pittsburgh" installation, each coil 7 feet, 7 inches in diameter. Note the high grade workmanship and uniformity of Pittsburgh Coils.

THESE Coils can be furnished up to 10-foot diameter in continuous coil; larger diameters are furnished in sections.



NOT a leak in a mile of Pittsburgh-built Coils; factory-tested under air pressure while submerged in water.

ELECTRICALLY welded, continuous — no couplings, no pipe fittings. That is the way Pittsburgh Coils are built for oil country and refinery use.

Then each individual Coil is tested before shipment—tested under heavy air-pressure while submerged in water. "There's not a leak in a mile of Pittsburgh-built Coils."

Proved absolutely secure, each Coil is serially numbered and tagged for identification — and for your protection. The metal tag is our word to you that the Coil is O. K.

You can get Pittsburgh-built Coils for all your requirements. Simply send us a blue print, rough sketch, or description for a prompt quotation.

There is extra service for you and a new measure of satisfaction in Pittsburgh-built Coils.

Pipe Bends
any Degree

All sizes up to six-inch. Furnished with steel protectors to safe-guard the threads.

Pittsburgh Pipe Coil & Bending Company
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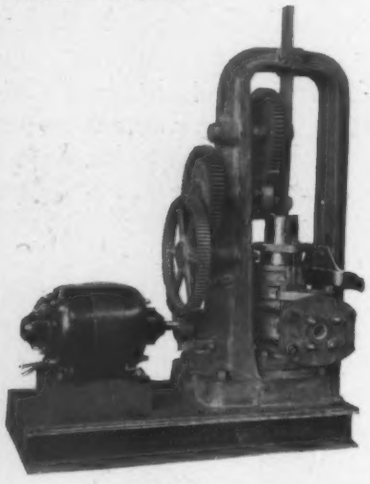
Measures Acid *Right!*

THIS Duriron Proportioning Pump will measure the exact amount of acid needed to treat oils and light distillates, thus cutting acid consumption to the minimum.

While measuring the acid needed, this pump forces it into the oil line against pressures up to 50 lbs. per square inch.

All parts of this pump coming in contact with the treating agent are acid-proof Duriron, and so immune to corrosive attack.



The Duriron Plunger Pump may be equipped for belt or direct motor drive, and by a convenient method of controlling the plunger stroke, or by using a variable speed drive, the pump is quickly and easily set to deliver the desired quantity of treating agent.

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why some refiners still cling to the obsolete types of earth burners. We can't answer that one. But we can answer all your questions about **NICHOLS HERRESHOFF FURNACES** and how they increase your filter runs while greatly reducing your filtering costs. Write us.

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NEW TEXAS COMPANY REFINERIES RECEIVING CRUDE

The Texas Pipe Line Company began delivering crude during the last week in July to the new refinery of The Texas Company at San Antonio. Rated capacity of the plant is 3000 barrels daily, with 3300 barrels capacity Holmes-Manley cracking process. The supply of crude is taken from the new trunk line of Texas Pipe Line Company leading out of West Texas to the Gulf Coast. A branch line from San Marcos to San Antonio, 46 miles long, of six-inch pipe, carries crude to the new plant.

The new El Paso refinery of The Texas Company is receiving crude through the Paso-Tex Pipe Line Company's line from West Texas fields. Texas Pipe Line Company delivers Winkler County crude to the trunk line of the Paso-Tex Pipe Line Company at Wink, Texas, for delivery in El Paso through the 200-mile eight-inch line. The El Paso refinery of The Texas Company has a rated capacity of 1500 barrels, with 1650 barrels capacity of the Holmes-Manley cracking process.

The Texas Company is operating the Galena-Signal Oil Company refinery on the Houston Ship Channel, which it recently acquired, on crude delivered to Houston by the Texas Pipe Line Company's trunk line from West Texas and Southeastern New Mexico. Most of the oil comes from Crane and Winkler Counties, West Texas, with some New Mexico production. The former plant of Galena Signal Oil Company has a rated capacity of 20,000 barrels daily, but is not now running to capacity.

GASOLINE PLANT TO BE BUILT NEAR CODY

Cody Petroleum Company, subsidiary of the Moody-Seagraves interests, will build a gasoline extraction plant near Cody, northern Wyoming, to handle 25 million cubic feet of gas per day from the company's holdings in the Oregon Basin field and in structures adjacent.

Beside the new gasoline plant, it is said that the company contemplates furnishing gas to the smelters of Anaconda Copper Company at Butte, via Helena. Other projects in the Rocky Mountain states are said to be under consideration.

W. D. Rial, superintendent of the Wilmington refinery of the Pan American Petroleum Company, under management of Richfield Oil Company, has tendered his resignation, effective August 1.

Rial started in the oil business with the Standard Oil Company of Indiana, and was for a number of years associated with the Standard Oil Company of California before going with the Doheny interests. He is considered an authority on the refining of by-products from California crude. As superintendent of the Wilmington refinery since ground was first broken for this plant more than six years ago, Rial has sponsored many outstanding improvements in refining methods.

As soon as he is relieved of his present duties he will take a needed rest at his ranch in Tuolumne County, but will return to Southern California in the fall to re-enter oil activities.

What is Perfect Piping?

PROOF against extremely high pressures—unyielding to intense heat—good and heavy in the walls—flawless, tough and uniform—expanding and contracting as a unit, without piled-up stress at any one point—long lengths for modern refining needs.

Pittsburgh Seamless fulfills every one of these requirements. It sets the standard for quality, low installation and maintenance costs and greatest ultimate economy.

Still Tubes ***Boiler Tubes*** ***Condenser Tubes*** ***Refinery Piping***

Steam Lines ***Oil and Gas Pipe Lines*** ***Tank Car Piping***

Coils ***Heating Systems*** ***High Pressure Piping***

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Time was when zero tests waited for zero weather. But now-a-days, the shortest distance between the oil well and the retail distributor lies along the path pioneered by such refrigeration engineers as are found on the staff of this Company.

Since 1867 Vilter precision products have established standards... since 1882 Vilter chilling methods have influenced the entire development of refrigeration... today Vilter equipment dominates the field.

Nowhere will you find engineers possessed of a better understanding of your chilling problems. The entire Vilter staff is ready to cooperate with your engineers to the fullest degree. Write, now, for details.

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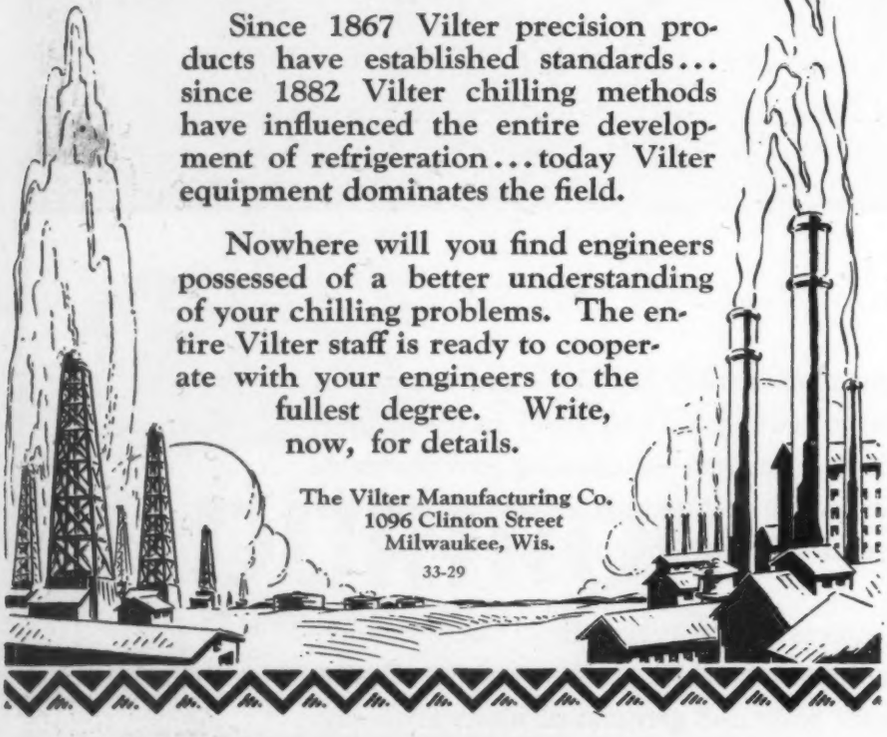

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EVENS & HOWARD FIRE BRICK CO.
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CALIFORNIA VAPOR PHASE CRACKING PLANT

Western Oil & Refining Company, Los Angeles, has started erection of its vapor phase cracking unit at Wilmington, California. This process, which is known as the True Vapor Phase Process, and marketed by the Petroleum Conversion Corporation, 136 Liberty Street, New York, is being installed by the Western True Vapor Phase Corporation, a subsidiary Company. The work is progressing under direction of engineers of the C. F. Braun & Company and Petroleum Conversion Corporation.

E. W. Beardsley, vice-president of Petroleum Conversion Corporation is vice-president and general manager of Western True Vapor Phase Corporation and the western installation is under his supervision. It is expected that the California installation will be placed in operation before the end of the year.

Shell Petroleum Corporation is to erect a similar True Vapor Phase unit at its Wood River, Illinois refinery which will be placed in operation early next year.

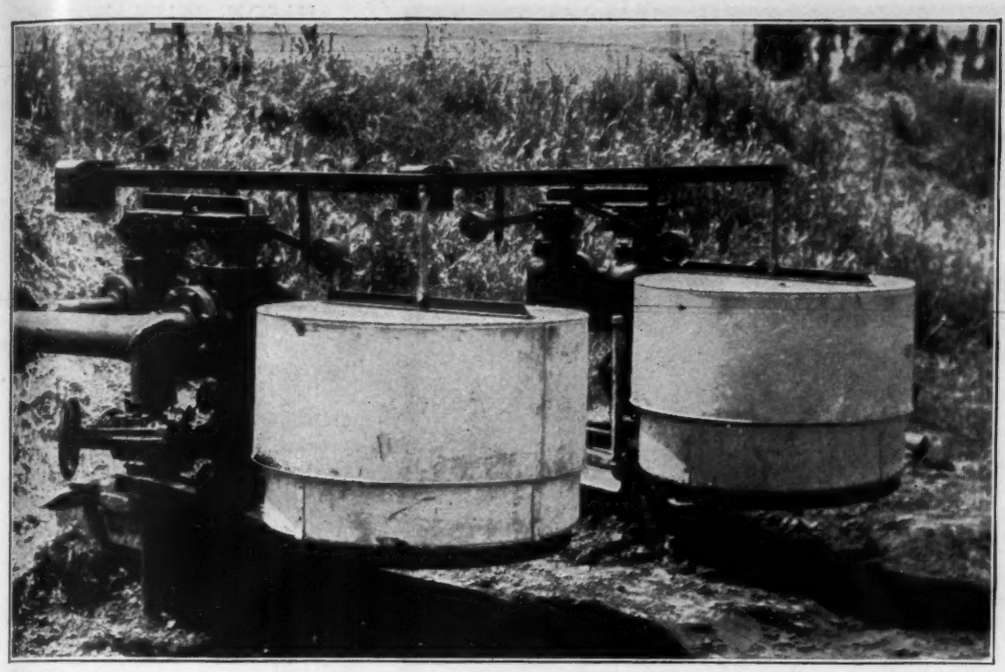
The distinguishing features claimed for the vapor phase cracking process are use of low pressure, elimination of hazard, freedom from corrosion, low percentage of gas formation, high percentage of gasoline produced, complete freedom from carbon troubles, simplicity of refining and treating finished product and a very high anti-knock rating of the gasoline.

The company's plant at Texas City has been in operation since the summer of 1928 under the direction and in association with a group of engineers from one of the largest oil companies in the world. Tests were run processing crudes of all types, as residual and gas oils, with resulting gasoline yields as high as 80 per cent. in some instances.

PURCHASE CONTROL

The Wayside Oil Corporation of Detroit, Michigan, has purchased controlling interest in the Michigan Central Refining Company, which latter company now has a refinery construction program nearing completion at Muskegon, Michigan. Ed. Lyon, formerly of the Wayco Oil Company, Detroit, is president of the Wayside Company and J. B. Wrather of Amarillo, Texas, is manager of the Michigan Central interests. The Northland Oil Company, Chicago, is to market the production of the refinery. C. L. Maguire, president of Northland Oil Company is actively interested in both the Michigan Central Refining Company and Wayside Oil Corporation.

James W. Gray, formerly of The Texas Company, has joined the staff of Luis De Florez. The De Florez offices are at 2 Rector Street, New York. Luis De Florez is the inventor of the circular retort of which some 40 units are now being installed or operated in the industry, and the De Florez cracking process, the second unit of which is now under construction at the Port Arthur plant of The Texas Company.



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Constantly it Guards Against Excess Tank Pressure and Vacuum—Against Costly Vent Losses

After two years of constant development and use under the full range of actual field conditions, this New Fisher No. 878 Control is announced to the industry.

Ever watchful, it stands guard on your crude storage, run-down and similar tanks.

In cases of more than normal pressure within the tank excess vapors are vented into the vacuum collection system. All vented gases are caught for recovery.

Vacuums within the tank cause the Fisher No. 878 to vent the dry gas into the tank.

The Fisher No. 878 controls tanks to within ½ inch of water pressure. Minute changes in tank pressure or vacuum are magnified by the large Gasmeter Bell into operating forces which control valves positively.

Bulletin 60 contains a complete description of this latest exclusive Fisher development. A copy will be sent without obligation.

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Steam Pump Governors
(10 to 1500 lbs.)
Boiler Feed Pumps
Fuel Oil Pumps
Vacuum Pumps
Receiver Tank Pumps

Pump By-Pass Valves
electric and motor-driven pumps

Reducing Valves, Pressure

Regulators
for all pressures—liquids, gases, steam

Differential Pressure Regulators

Vacuum Regulators

Strainers, Pipe, Suction and Drip Pocket

Liquid Level Controls
Direct and Remote Type

Lever Valves
air, gas, or liquid

FloatValves—Fluid Mixers

Hydraulically Operated Valves

Relief Valves

Back Pressure Valves

Steam Traps—Air Traps

Gasoline Traps—Grease Traps

Exhaust Heads

Steam and Oil Separators

Drip Pockets

Vapor Pressure Controls
for oil storage tanks

Boiler Gas Fuel Governors

Gas Engine Fuel Regulators

Automatic Gas Relief Valves

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main and home service

Liquefied Petroleum Gas Regulators
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Parker Tube Couplings hold hot oil or gas under excessively high pressures—they may be used repeatedly—they solve many Plumbing Problems, characteristic of the refining industry.

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EASON BUYS BOLENE REFINING COMPANY

Through the purchase of controlling interest in the Bolene Refining Company, Enid, Oklahoma, and the Healdton Oil & Gas Company of Oklahoma, Eason Oil Company, oil marketing company of Enid, headed by T. T. Eason, president, becomes a well rounded organization engaging in producing, refining and marketing of petroleum and its products.

The company will include Ethyl gasoline sales in its expansion program, marketing in Oklahoma, Wisconsin, Minnesota, Illinois, Iowa and Kansas.

HOUSTON REFINERY NEARING COMPLETION

Shell Petroleum Corporation has made record time in the construction of its 20,000-barrel refinery on the Houston Ship Channel and indications are that the plant will be placed in operation possibly late in August. Originally it was reported that this large refinery would not enter the markets with products before 1930. The plant will operate on West Texas crudes delivered to the refinery through Shell Pipe Line Company's line from that area to the coast. The refinery site is 350 acres. Latest modern equipment is being installed for the preparation of premium fuels of high anti-knock qualities. R. B. High is in charge of operation.

E. G. Guy, formerly secretary and manager of refinery operation for Orient Petroleum Company, Wichita Falls, Texas, is now at Muskegon, Michigan, supervising construction of the Old Dutch Refining Company's refinery here. He will also have charge of its operation upon completion of erection which is planned for September 1. The refinery is located on the Grand Trunk Western Railway just east of the city limits of Muskegon.

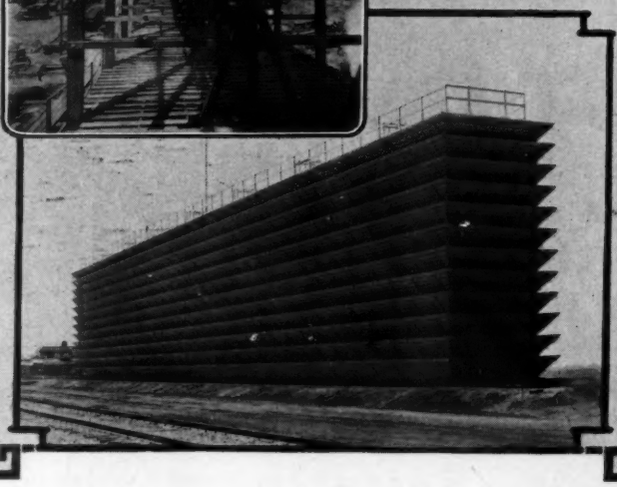
Officers of the Old Dutch Refining Company are: Walter Schuttler, president; Walter E. Anderson, vice-president and general manager; Ernest L. Hughes, vice-president, and John Borden, secretary and treasurer. The company is capitalized at $500,000, of which about $300,000 is to be expended for refinery construction.

PURE OIL COMPANY MANUFACTURES SOAPS

At its new grease plant, Marcus Hook, Pennsylvania, the Pure Oil Company has installed a small plant for the manufacture of soaps. The plant is of latest modern design, although of relatively small capacity. These soaps will be distributed through Pure Oil Company stations and to jobbers as automobile washing soaps and a large proportion of the production will be utilized by the company's own manufacturing and distributing departments.

Mid-Texas Oil & Gas Company, Mid-Texas Refining Company and Mid-Texas Pipe Line Company, Abilene, Texas, plan the construction of a gasoline plant, booster plant, and repressuring plant for old wells, construction work to be started at once. Estimated cost is $38,000.

Structurally Superior



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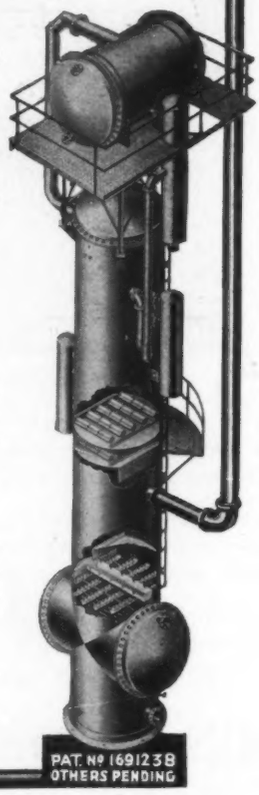

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NATURAL GASOLINE PLANT DESIGN AND OPERATION

ANALYTICAL AND RESEARCH LABORATORIES

FRACTIONAL DISTILLATION ANALYSIS

DE FLOREZ UNIT AT PORT ARTHUR

The Texas Company is erecting the second unit of the DeFlorez vapor phase cracking unit at its Port Arthur refinery. The first De Florez unit was built at the Bayonne, New Jersey refinery of the Gulf Refining Company. The Port Arthur unit has a reported capacity of 1000 barrels of gasoline daily.

ADDING FRACTIONATING TOWERS

The Swan & Finch Refinery at Warren, Pennsylvania, is adding three bubble type fractionating columns to its distillation equipment. One tower is the design of H. S. Bell, Refinery Engineer, Woolworth Building, New York City, and the other two were designed by Dr. E. H. Leslie, Oil City, Pennsylvania. The company has recently completed enlarging its distillation capacity and installing additional power plant equipment and a new steel and concrete loading rack.

KETTLEMAN HILLS GASOLINE PRODUCTION GROWING

Standard Gasoline Company (Standard Oil Company of California) has completed construction of a natural gasoline plant in the Kettleman Hills field, California, which is located in the same section as its well No. 81, now drilling. The company has been making preparation to handle the wet gas production which will be available upon completion of its drilling wells. The first plant has a rated capacity of 30,000 gallons daily.

The Texas Company, which was the first to place natural gasoline extraction equipment in the Kettleman Hills field, has found it necessary to enlarge its original plant through the addition of six units which enable the plant to process a total of 100,000 cubic feet of gas daily. The Texas Company is taking gas from the discovery well of the Milham Exploration Company.

It is anticipated the Kettleman Hills area will become a large producer of natural gasoline.

GRAY COUNTY, TEXAS, GASOLINE PLANT

Cockrell, McIlroy and associates, Amarillo, Texas, are planning the construction of a natural gasoline plant on the Clayton Farm, Gray County, Texas. The location is Section 50, Block 25, H. & G. N. survey. Residue gas is to be sold to carbon black plants.

NEW PANHANDLE GASOLINE PLANT

The Henderson Company, Tulsa, of which F. C. Henderson is president, is building an absorption natural gasoline plant at Sanford, in the Texas Panhandle. The plant will have a rated capacity of 25,000 gallons daily. Tulsa Type distillation units and Jackson absorbers with oil and water circulation by Worthington pumps steam turbine driven. The Henderson Company operators a 9000-gallon plant at Delaware, Oklahoma.

PHILLIPS IN JACK COUNTY

Phillips Petroleum Company is starting construction work on an absorption gasoline plant to operate on sweet gas produced along with high gravity oil from the 2900-3100-foot horizon in the Bryson field, Jack County, Texas. This field recently contributed a new oil and gas horizon from lime at the 4500-foot level, and the gas tests about three gallons of gasoline per thousand cubic feet.

CHESTNUT & SMITH TO BUILD

Chestnut & Smith Corporation is to erect a natural gasoline plant in the Morris field, Coleman County, where approximately 50 million cubic feet of wet gas has been developed within the past six weeks, including a number of wells on leases held jointly by the Chestnut & Smith Corporation and the Eastland Oil Company. The residue gas from this plant will be taken by the Lone Star Gas Company.

NEW ARAB PLANT

The Arab Gasoline Corporation, which maintains headquarters at Eastland, Texas, in the Exchange National Bank Building, has contracted to erect an absorption gasoline plant in the Ramsower pool, located north of Eastland and in northern Eastland County. The plant will use the absorption process, with a rated capacity of 12 million cubic feet of gas daily. A plant site has been purchased in the southwestern corner of the B. B. B. & C. Ry. Survey No. 56.

PYOTE, TEXAS, PLANT SHUT DOWN

Amarillo Producers & Refiners Corporation suspended operation of its skimming plant at Pyote, Texas, early in July and surrendered its crude contract with the Texon Oil & Land Company. This plant has been operating on Winkler County crude.

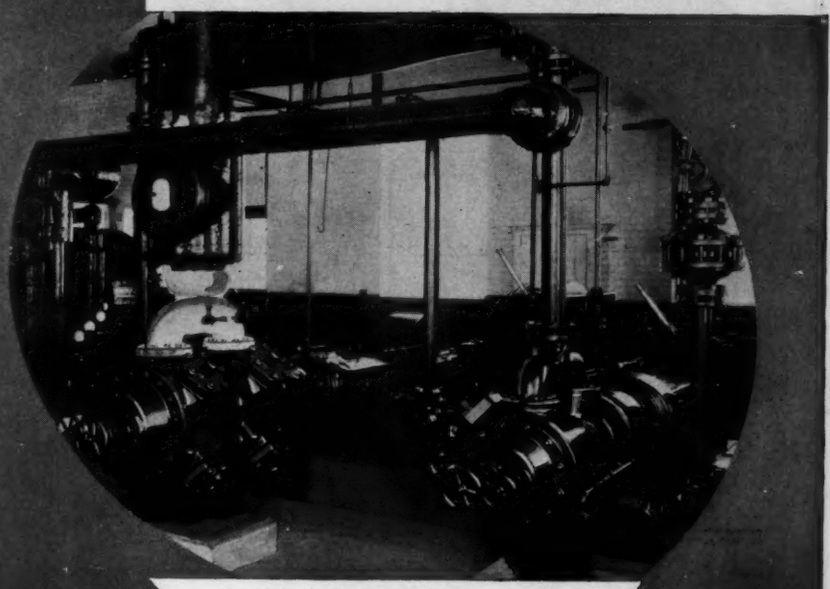
ST. LOUIS FIELD PLANT

Gillespie and Moran are building a new gasoline plant in the St. Louis field, Pottawatomie County, Oklahoma. The plant is two miles west and just north of the townsite of St. Louis. The first unit is expected to be in operation at once.

ASPHALT SALES DECLINE

Washington, D. C.—A decline of 2.3 per cent in sales of asphalt during 1928 is recorded in statistics compiled by the United States Bureau of Mines. The fact that sales of paving asphalt showed a decrease of 6.2 per cent during that year, due chiefly to increased use of other paving materials, accounts for the slight decline in total sales. On the other hand, the report shows that sales of road oil increased 45.8 per cent, while sales of roofing material and miscellaneous uses, such as battery sealing compounds, binders, insulating, as well as its use in the manufacture of paints, enamels, varnishes and coatsings, showed increased demand. Total sales of solid, semi-solid and liquid asphalt, prepared from petroleum, declined from 3,654,340 short tons, valued

−30° F. Brine!



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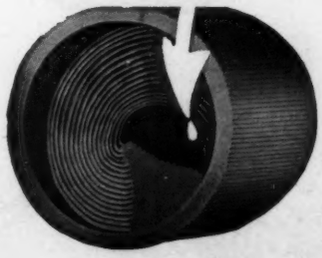

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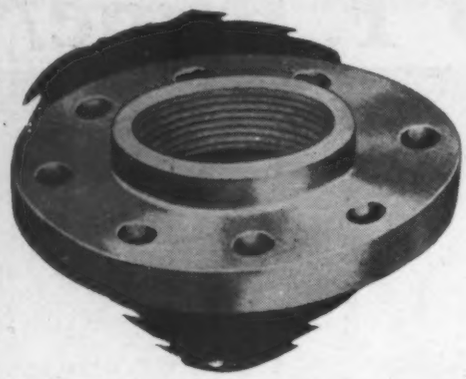

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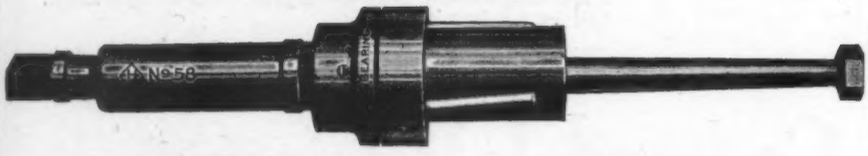

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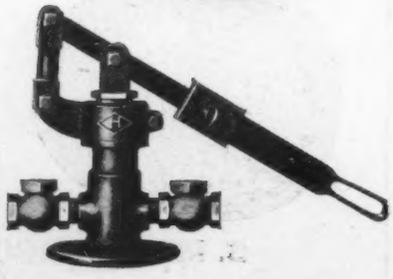

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at $51,661,570, in 1927, to 3,572,274 tons, valued at $46,268,546, in 1928. Road oil sales increased from 297,110 short tons, or about 1,818,300 barrels, in 1927, to 433,255 tons, or about 2,651,500 barrels, in 1928. The sales value of road oil increased from $3,129,520, in 1927, to $3,844,439, in 1928. Prices of nearly all grades were lower in 1928 than in 1927. The average sales value per ton of all asphaltic products, including road oil, fell from $13.87, in 1927, to $12.50, in 1928.

For the first time since 1921, refinery production of asphalt decreased, from 3,817,539 short tons, in 1927, to 3,542,941 tons in 1928. Substantial gains in production of asphalt in refineries of the Middle West and of California did not suffice to offset the lowered production of the Atlantic Coast and Gulf Coast refineries, which furnished 69.2 per cent. of the national output.

W. H. Hastings, 55, superintendent of the Corsicana, Texas, refinery of the Magnolia Petroleum Company, died at his home in the latter city on July 21, following a long illness. Hastings was a native of Olean, N. Y., and has been engaged in the refining business practically all of his life, having made his start in the Olean plant of the Standard Oil Company. He moved to Corsicana in 1899, and obtained a position with the local refinery that later became part of the holdings of the Magnolia Petroleum Company.

A. D. David, formerly general manager of refineries for the Continental Oil Company for the last several years, has resigned to join the sales and engineering organization of M. W. Kellogg Company. Prior to his connection with the Continental Oil Company, Mr. David was with Universal Oil Products Company. During his incumbency in the general managers position with the Continental Oil Company the Sapulpa refinery was enlarged and modernized, the old Texhoma Refinery at Wichita Falls was taken over and enlarged and other company manufacturing plants were modernized.

G. W. FOOTE WITH PERFEX

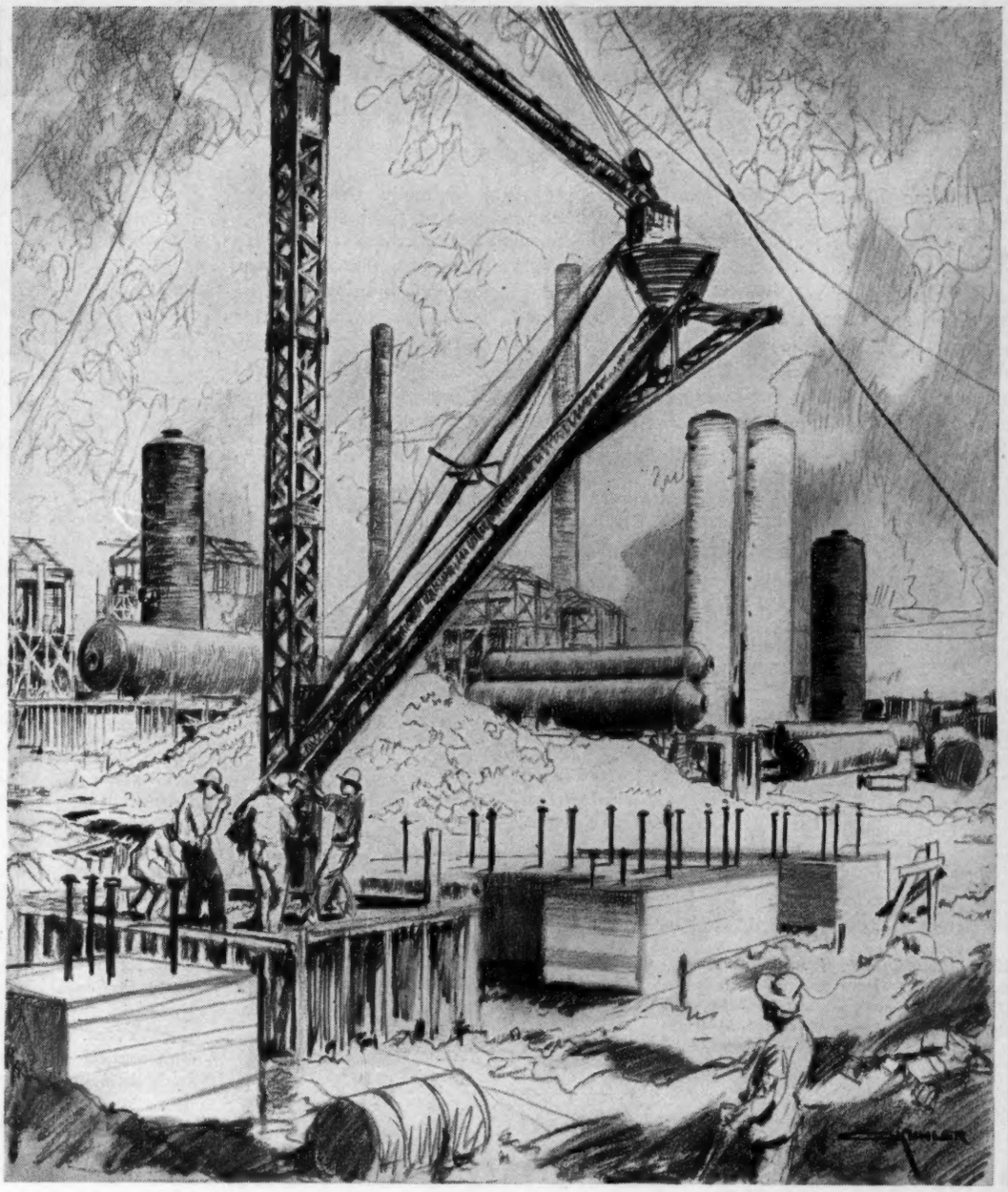
G. W. Foote has been appointed factory manager of the Perfex Corporation, manufacturers of heavy duty industrial engine cooling radiators, D. T. MacLeod, president of the company recently announced.

Foote formerly was associated with the Republic Metalware Company, Buffalo, where he was general superintendent in charge of production.

MERCO-NORDSTROM OPENS OFFICE

Merco Nordstrom Valve Company has opened an office in El Paso, at 111 South Virginia Street. Announcement is also made of the removal of the Seattle office to the Buyers Building, Portland. The company manufactures lubricated valves.

V. V. Jacomini was elected a director of F. C. Braun & Company, July 17. He has managed the company's Dallas, Texas, branch for several years and has served the company, just prior to his recent promotion, as its executive engineer.



Cracking PLANTS TO PRODUCE GASOLINE OF HIGHEST ANTI-KNOCK PROPERTIES

Recent developments in cracking plant design make practical the production of a gasoline possessing the highest anti-knock properties, without the addition of chemical compounds. This company is now prepared to design and build plants for producing anti-knock gasoline.

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ABSTRACTS OF TECHNICAL LITERATURE

Of Particular Interest to the Plant Operator

By H. L. KAUFFMAN

From: Refining in Europe. Waterman and Perquin. (Progress of Naphthology During 1927. *J. I. P. T., Aug.,* 1928, *p* 553).

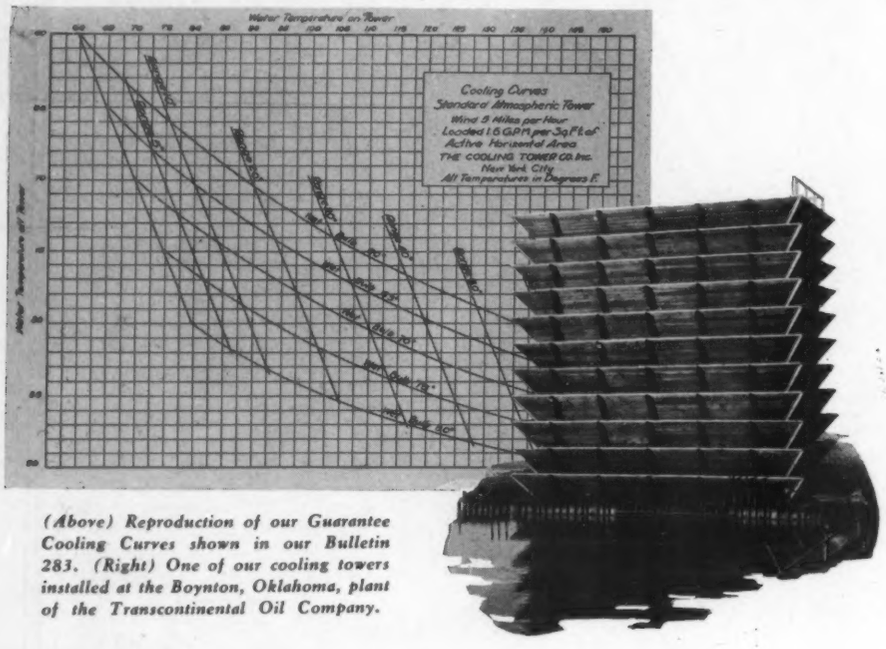
Waterman and Perquin compared the products which are formed by cracking paraffin wax at 450° with those obtained in berginization. They especially investigated the gasoline fractions. The boiling-point curves of both gasoline types were interrupted and distinctly showed very pronounced maxima at the boiling points of the normal hydrocarbons pentane to octane. In berginization, the percentage of these was higher than in cracking. The products of berginization are more stable than those of cracking. Even after one year the refractivity had only changed slightly. The berginization product contains 10 per cent. of unsaturates in the hexane-to-octane fractions. The cracked distillates are more unsaturated, the bromine number, specific gravity, refractive index, and dispersivity are higher, the aniline point lower. It seems that between the maxima of the normal aliphathic hydrocarbons there are other types with higher dispersivity and lower bromine number and aniline point.

* * *

Refining Studies in England and Germany. Waterman. (Progress in Naphthology during 1926. *J. I. P. T., Aug.,* 1927, *pp* 537-38. *Libr. Bull., U. O. P. Co., Vol.* 2, *No.* 40, *pp* 345-46).

The study of the anti-knock problem has proved the importance of the presence of unsaturated and aromatic hydrocarbons. Whereas the opinion several years ago was that the unsaturated hydrocarbons lowered the quality of the gasoline, the opposite opinion has now been settled. J. Tausz (Z. angew. Chem., 1926, 39, 685.) states that the olefines and diolefines do not cause the coloring and sediment formation of the different species of gasolines, but is of the opinion that the chief cause of these deterrent properties is unsaturated hydrocarbons of a cyclic character, to which also belong unsaturated five-ring hydrocarbons. It is known that olefines may be oxidized, but the oxidation itself does not cause the coloring. Only in combination, with amines for instance, there may be formation of a dark color. In this connection, the determination of unsaturated and aromatic hydrocarbons in gasoline is important, and J. S. S. Brame (Journ. Inst. Petr. Tech., 1926, 12, (54), 48.), in a discussion on the action of sulphuric acid of different concentrations on some hydrocarbons, has given a summary on the determination of these compounds. The halogen addition of the hydrocarbons was also considered, and W. R. Ormandy and E. C. Craven discuss their experiments on the action of sulphuric acid on gasoline. These investigators also studied the influence of a change in the concentration of the sulphuric acid used. They found that the specific weight and the refractive indices increase until the strength of the acid has reached about 88 per cent., which they explain as caused by polmerization and removal of unsaturated hydrocarbons. At higher acid strengths the aromatics are removed, and the specific gravity and the refraction are lowered. The concentration of 88 per cent. seems to be the critical point where the extraction of the unsaturated hydrocarbons is complete and the extraction of the aromatics just beginning. The large increase in acid loss, which occurs if the acid strength exceeds 100 per cent., seems to prove that the free SO_3 has a very marked influence.

German investigators have, however,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obtained results which do not agree with those obtained in England. E. H. Riesenfeld and G. Bandte (Erdol und Teer, 1926, 2, 587) also studied the method of determination of unsaturated and aromatic hydrocarbons in gasolines, and their experiments led to their publishing the following methods of testing:

1. Gasolines containing less than five per cent. by volume of unsaturated hydrocarbons are treated with sulphuric acid of 94 per cent. (two parts acid to one part gasoline), cooled with ice. The decrease in volume gives the percentage of unsaturated hydrocarbons. A second experiment is carried out at 40-45°C. with sulfuric acid of 100 per cent. in the same proportions. The decrease in volume gives the combined content of unsaturated and aromatic hydrocarbons. From the difference of the two determinations, the aromatic content may be calculated.

2. Mixtures of benzene with the gasolines mentioned above, with an aromatic content of between 20 and 50 per cent. by volume, are treated by the same method, with the exception that 92 per cent. acid is used in place of 94 per cent.

Mixtures having an aromatic content of over 50 per cent. by volume are first diluted with normal gasoline (Kahlbaum) in the proportions of 1:1, and the determinations then carried out.

The authors point out that their method only holds for most of the German commercial gasolines, the unsaturated percentage of which is generally less than five per cent. by volume. Their work cannot yet be considered as of general application.

* * *

Facts and Observations Upon the Modern Means of Refining. Roseanu. (Mon. Petr. Roum., Jan. 15, 1929, *page* 115; *Libr. Bull., U. O. P. Co., Vol.* 4, *No.* 7.)

At cracking temperatures of 230-260° (446-500°F.) terpenic hydrocarbons are produced, which at a temperature of 400° go over to aromatics. At temperatures above 500° (932°F.) the process of forming benzene hydrocarbons is reversible and when maximum temperatuers are passed, at certain pressures, we get more gas than light gasoline hydrocarbons or more heavy hydrocarbons than light. Benzene at the higher temperatures is transformed into diphenyl or diphenyl benzol and hydrogen. At lower pressures the benzene may be transformed into naphthalene, anthracene, and their derivatives.

From the incomplete researches made thus far it is possible to identify several aromatic hydrocarbons in cracked gasoline of 0.750 sp. gr. at 15°C. by the melting point of the picrates. It has been possible to identify thus benzene and some of its homologues, mesitylene, pseudocumol, indene, fluorene, terpenic compounds, triphenyl-naphthalenes and naphthalene in considerable amounts. The presence of these higher cyclic hydrocarbons influences the fuel properties of the cracked gasolines; the unsaturation of the hydrocarbons affects the stability of the chemical composition. But the fractions which are rich in terpenic and higher cyclic

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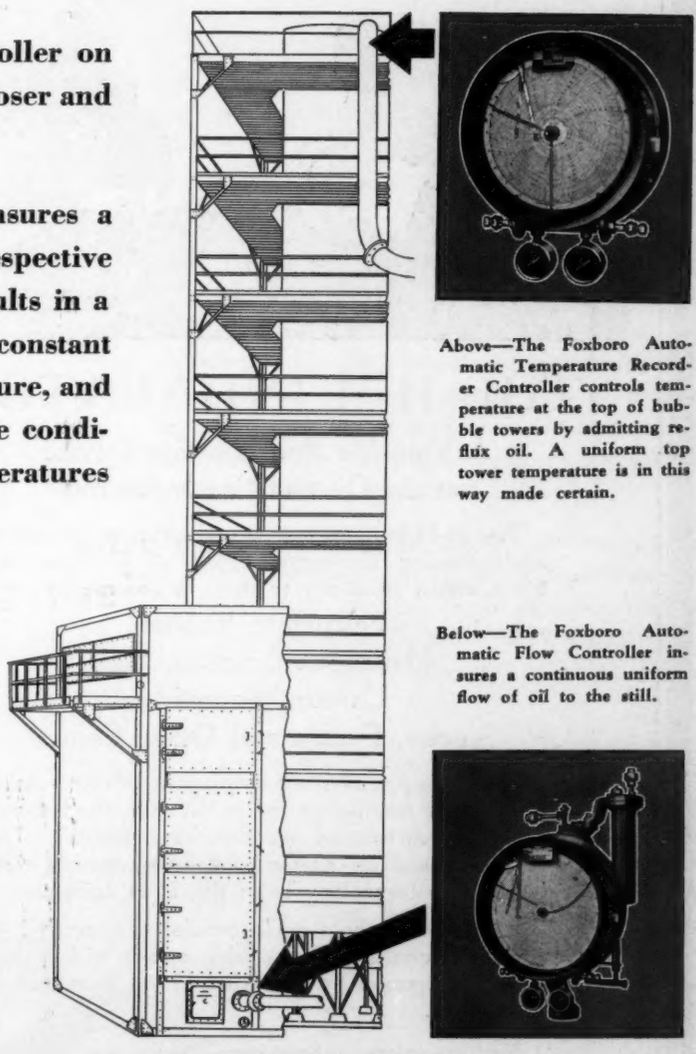

Above—The Foxboro Automatic Temperature Recorder Controller controls temperature at the top of bubble towers by admitting reflux oil. A uniform top tower temperature is in this way made certain.

Below—The Foxboro Automatic Flow Controller insures a continuous uniform flow of oil to the still.

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hydrocarbons form a product superior in every way to white spirit, which is used as a substitute for turpentine and in combination with it in the lac and varnish industry. Oil of turpentine having a sp. gr. of 0.856 and a boiling point of 160°C., when passed through a red-hot iron tube is converted to isoprene, m-xylol, naphthalene, anthracene; that is, to a product having almost the same properties as the terpenic hydrocarbons obtained by cracking, and one which may be regarded as a transition stage between the naphthenic hydrocarbons of heavy oils and the aromatics of the cracked oil.

Of ordinary white spirit, 48 per cent. distils over below 160°C. (320°F.); only three per cent. of cracked white spirit is volatile below this temperature; 71 per cent. of the cracked spirit goes over between 160°C. and 180°C. (356°F.), as against 39 per cent. of the ordinary. The flash point of the cracked white spirit is higher than that of the ordinary. All these characteristics indicate that the cracked spirit is the better substitute for oil of turpentine in the lac and dye industries.

* * *

Cracking

The Fundamental Factors of Liquid-Phase Cracking. Sakhanov and Tilichev. (*J. I. P. T., Oct.*, 1928, *p.* 761).

Cracking results depend upon the factors time, temperature, pressure, and kind of cracking stock. Velocity of cracking decreases with the prolongation of the operation as the result of diminishing quantities of material to crack; at first the velocity of gasoline production is proportional to the time. The higher fractions of all oil crack more rapidly than the lower; straight-run oils more rapidly than cracked. Rate of cracking doubles for every 10°C. rise in temperature. The optimum temperature range for liquid-phase cracking is probably 450°-475°C.; this gives high cracking velocity and at the same time avoids excessive coke and gas formation. Pressure does not affect velocity of cracking; it does favor heat transfer, the avoidance of local overheating, and fuel economy.

Condensation takes place readily in the higher fractions during the process of cracking, and the end product of condensation is coke. Residues and heavy crudes yield more coke than distillates of the same gravity, partly because they contain resins and asphaltenes, which coke readily. Velocity of coke formation increases with increased time of cracking; and is multiplied by six with every rise of 25°C. in temperature. Better yields of gasoline are obtained by recycling an oil than by prolonging a single run till coke formation becomes predominant. Four successive experiments in cracking a light gas oil at 450°C., in the 2d, 3d, and 4th experiments taking the fraction of the residue which boiled above 200°C. and recycling once, twice, and three times respectively, gave 17.5, 39.7, 49.0, and 55.2 per cent. of gasoline. By this manner of operating, a maximum of about 60 per cent. of gasoline can be obtained with a moderate amount of coke, or 65 per cent. with considerable coke formed.

* * *

Fractionation

Improved Fractionation for Cracking Processes. Keyes. (*Chem. and Met. Eng., Feb.* 1929, *p.* 78).

The fractionating schemes here described can readily be applied to such cracking processes as the Holmes-Manley and the Dubbs.

(1) The vapors are separated from the liquids and solids and are passed, in a coil, into the bottom of a fractionating column, heating whatever liquid has accumulated there and driving out any gasoline present; pass out, and then re-enter the column higher up through a reducing valve. A pressure reduction of 50 to 100 pounds is permitted and some vaporization takes place. Cold feed in a coil at the top of the column provides the reflux, and gasoline passes out at the top of the column to a separator where gas is separated from it as in the usual practice.

(2) Crude tar is passed into the top of a stripping column through a reducing valve and steam or gas is introduced at the bottom. Any gasoline or re-cycle stock is carried out at the top. The "reduced" tar comes out at the bottom of the column and the vapors leaving at the top are introduced, under somewhat diminished pressure, into a column like the one previously described. Recycle stock comes from the bottom of this column,

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and gasoline and gas from the top as before.

(3) When it is desired to heat the feed in direct contact with the vapors, the vapors are introduced from the reaction chamber into the bottom of the column as before, carried out and re-introduced about one-third of the way up, meeting the charging stock which has already been partially heated in a coil in the top where it acted as reflux. The vapors complete the heating. The feed is stripped of its valuable fractions in the lower third of the column. In the upper third, recycle stock is separated from the gasoline and gas, and also goes out at the bottom. The gasoline and gas go out at the top and are taken to the separator as before.

One vapor-fractionating column will probably be needed for each cracking unit; but a single tar-fractionating unit should be enough to serve several cracking units.

* * *

Treating

The Study of Physical Processes of Refining Spirit, Kerosene, Paraffin and Lubricants. Guiselin, (Bull. Soc. Chim. Ind. 7th Congress of Industrial Chemistry, 1927. *J. I. P. T., Dec.,* 1927, *p.* 290 *A. Libr. Bull., U. O. P. Co., Vol.* 3, *No.* 8, *pp.* 76-77).

Numerous hydrocarbons and complex organic compounds ordinarily met with in the products of bacteriological, chemical, physical, magnetic and catalytic transformation of natural materials constituting beds of bitumen and petroleum have, until recently, been considered as impurities. Certain of these react on the metal of apparatus used for storage, transport, or combustion, whilst others are detrimental to good lubrication or combustion in lamps, motors and generators. It is economically important that research should find some use for these by-products and losses. The necessity has been felt of isolating the impurities of mineral oils instead of destroying them by out-of-date methods of refining by oxidizing acids. Fractional distillation should be such that the heat will not destroy these impurities, which are unfortunately unstable when heated. Their complex composition also prevents their complete or even sufficient separation.

M. Guiselin has frequently stressed the importance of the use of physical treatments by porous bodies, such as clays, bauxites or silicates. Another method of treatment analogous to these is that of Edeleanu, which refines oils by means of the solvent action of liquid sulphur dioxide. At a temperature of 15°C. (59°F.), sulphur dioxide dissolves practically all types of petroleum. This solution, however, can only be carried out in a closed vessel, owing to the vapor tension of SO_2 at this temperature.

If the solution be cooled, the operation can theoretically be carried out in open vessels, and one would then perceive the formation of two layers of different color and non-miscible. An examination of the two layers shows that the lower one consists of SO_2 with aromatic, cyclic, naphthenic, unsaturated, oxygen and sul-

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"V" Pilot Packing serves longer on practically every refinery application because of its unique and patented construction. Its continuous, solid "V"-shaped bar gives a metallic face which offers less frictional resistance on the rod or plunger. Its resilient asbestos back compensates for the vibration of the rod, providing a perfect seal with minimum friction.

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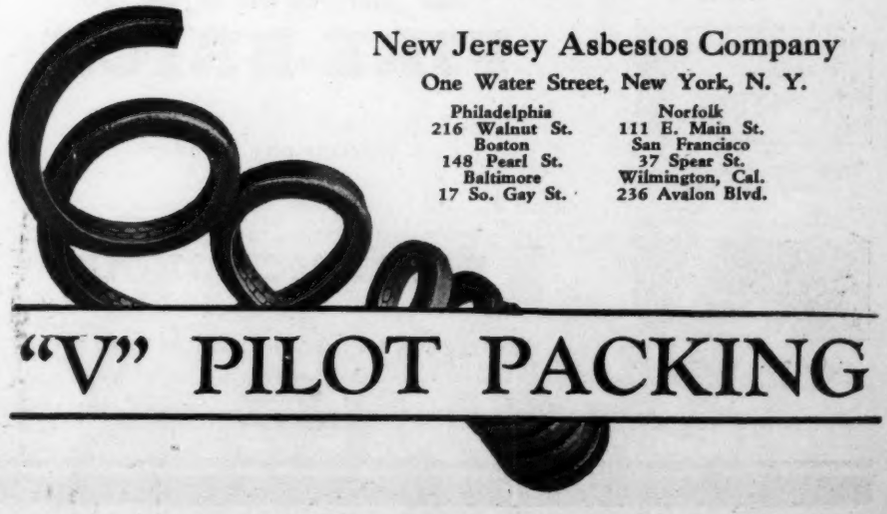

phur compounds in solution. These compounds are those usually considered as impurities and may comprise olefines, resins, asphalts, thiophenes, thiophanes, pyridine bases and organic acids, the whole being mixed with traces of paraffin hydrocarbons. The upper layer consists mainly of paraffin hydrocarbons containing a little SO_2 and impurities.

The burning-oil fractions of paraffin hydrocarbons behave particularly well in lamps fitted with circular burners and wicks as used in France. The method constitutes an excellent physical process whereby good-quality lamp oils may be separated from any crude kerosene.

It is only necessary to separate the two layers in order to obtain without loss, firstly an excellent lamp oil, and secondly, hydrocarbons charged with impurities. The SO_2 is reliquefied after being evaporated off from the solutions.

The situation, however, has changed very rapidly, for these by-products were employed in numerous ways.

The ease with which this method allows of the concentration of the major portion of aromatics contained in crude distillates, was made use of during the war in the manufacture of explosives by treatment of Borneo spirit. Again, the method furnishes a source of the least detonating of spirits, and also of a means of refining paraffin and lubrication fractions from crude mineral oils.

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Filtration

Petroleum and the Filtering Earths. Nutting (*Jour. Wash. Acad. Sci.* 18, 409 (1928). *C. A., Jan.* 20, 1929, *p.* 507).

Filtering materials are effective because of the open oxygen and silicon bonds. These are producd by removal of water from terminal hydroxyl radicals. They act by attacking certain less firmly bound radicals of the hydrocarbons. The result may be mere adhesion but is in many cases a surface reaction in which a film or organic silicate is formed over the surface of the filter grains. Many of the organic silicates so formed are insoluble in any single known solvent. Clays of the kaolin type do not filter because they contain no hydroxyl water to be driven off, leaving open bonds. Clays of the bentonite type make only poor filters even after acid treatment because they contain only a little alkali replaceable by hydroxyl. Good filters are (1) those well supplied with hydroxyl water removable by moderate heating and (2) those having originally had terminal alkali radicals subsequently converted to hydroxyl by acid treatment. The selective action of filters is readily accounted for by the varying activity of open bonds toward organic radicals retained by bonds of varying strength.

* * *

OF PARTICULAR INTEREST TO THE CHEMIST

Testing and Analysis

Spindler and Hoyer Viscosimeter (*Instruments, Vol.* 1, *No.* 3, *pp.* 163-165).

This viscosimeter registers automatically the damping of a pendulum which swings in oil. This damping is a measurement of the viscosity.

The new viscosimeter has the following advantages:

1. Greater accuracy.
2. Applicable within a very large viscosity range without interruption of measurement or cleaning of the instrument, respectively.
3. Time required for each measurement about 10 minutes.
4. Can be used for high temperatures (150°C. and more).
5. Automatic registration of the curve, thus eliminating possible errors of the observer.
6. The possibility of measuring impure or graphited oils.

The pendulum-viscosimeter (Fig. 1.) consists of a pendulum (a) with an adjustable weight (b). The pendulum is attached to beam (c), the latter being provided with adjusting screws (d) for regulating the time of oscillation. Above the beam (c) a frame is provided carrying the small ball (f) and the mirror (g). The ball emerges to a certain depth into the oil vessel (h). An overflow tube (i) provides for constant heights of the liquid when, in case of warming, the oil begins to expand. An electric heating device is built into the outer vessel (k) in order to make it possible to obtain any required temperature of the liquid.

The photographic film rolls off in a light tight case (1), and the oscillation is registered automatically on the film in such

manner that a light spot from lamp (m) with a diaphragm of small aperture (n) is projected through lens (o) in tube (p) by means of mirror (g).

The mirror, being permanently fixed to beam (c) makes all movements with pendulum (a), while the film is rolled off by means of a modified Morse apparatus (q) and driving card (r).

The case (1) contains a table which flattens the film while gliding over it and which is provided with a pointed needle to draw the zero line on the film. The electro magnet (s) permits the pendulum to swing only from a given distance and assures accurate release.

Two special designed gauges are provided to measure and check the correct immersion depth of ball (f) in the liquid. The one is for measuring the distance between ball (f) and upper edge of beam (c) and the other for measuring the distance between the edge of the overflow tube and the upper edge of the beam. The temprature of the oil is taken with thermometer (t), the bulb of which is enclosed in a ball-like cover of 12.71 mm. diameter and which causes the friction of the oil particles in the liquid. Thereby the temperature of the oil particles subject to friction during the oscillation of the pendulum is measured, and no error can occur in case temperature variations should exist within the oil bath. However, same can be checked by using a second thermometer. Uniformity in temperature may be obtained by stirring the oil bath with the pendulum before taking measurements. The magnet (s) is adjusted in such way that the primary angle of oscillation is 10° for the vertical position of the pendulum. For the approximate determination of the decreasing angle of the pendulum during the oscillation following same can be read from the degree scale (v) attached to the base of the center column.

The liquid to be examined is poured into the oil vessel (h) and brought to the desired temperature, during which time the pendulum should swing in order to obtain uniform temperature throughout the oil vessel. The pendulum is then arrested by the electro magnet, the film driving mechanism is put in motion and the lamp switched on. The pendulum is released and the curve is taken to a certain (about 30°) angle of oscillation. The time of oscillation need not be calculated to obtain the damping co-value and therefore a possible uneven movement of the film does not cause any disturbance.

Photographic paper can be used instead of film when copies are not required. The film can be inserted in daylight.

The stage is provided with a pointed needle upon which the light spot must point when the pendulum is at rest, and any deviation therefrom is adjusted by the mirror or can be later calculated when the measurements are made.

A sharply focused light spot on the film is obtained by displacing the large tube (p) with lens (o), the latter producing a sharply focused image of diaphragm (n).

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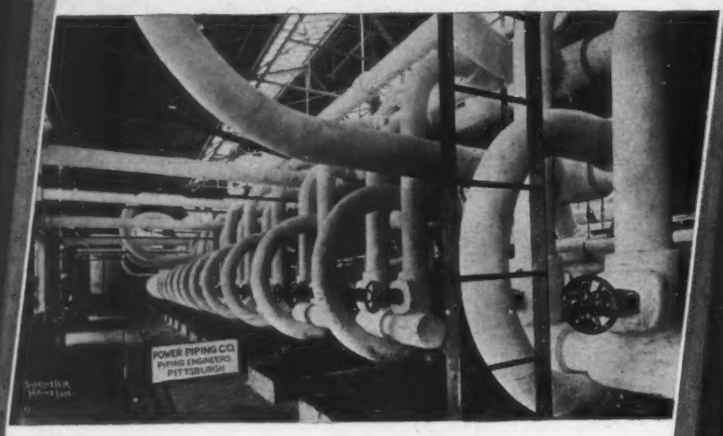

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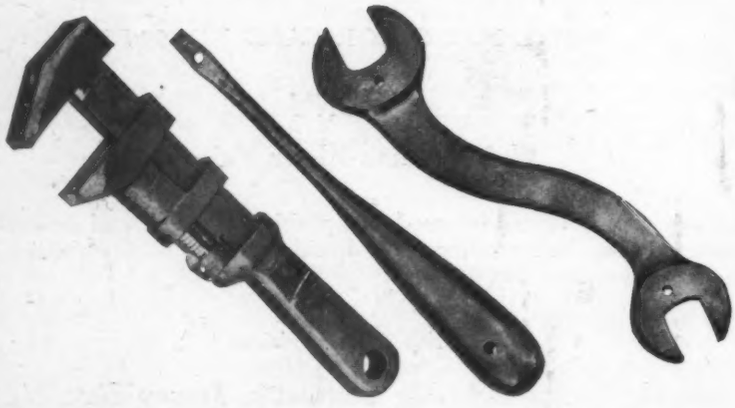

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Griffith and Holliday. (*J. S. C. I., Oct.* 19, 1928, *p.* 311*T*).

Roscoe and Scudder, in 1891, and Bunte and Terres in 1922 stated that when water gas or coal gas is stored under pressure in iron containers, iron carbonyl is formed. Griffith and Scudder thought that if this occurred in the synthesis of methyl alcohol from carbon monoxide and hydrogen, iron might be deposited upon the catalyst with unfavorable results. Examination showed iron on the catalyst and in the methly alcohol formed. Passing the gas containing the iron carbonyl through concentrated sulfuric acid was found to remove the iron carbonyl quantatively. The method fixed upon for determining the iron was to evaporate the acid to dryness, re-dissolve the iron, treat with potassium ferrocyanide and estimate colorimetrically the uncoagulated Prussian blue formed. A second method which proved to be quantitative was to pass the gas through Urbain charcoal, soak the charcoal over night in sulfuric acid, ash it in a muffler, and proceed as before.

Examination of the gas from the active-iron catalytic reaction tube showed iron equivalent to 1.26 g. iron carbonyl per 1000 litres. Carbon monoxide compressed in storage holders contained iron equivalent to 0.1853 g. of iron carbonyl per 1000 liters; town gas gave up 0.00017 g. of carbonyl to sulfuric acid per 1000 liters but nearly twice this amount to charcoal. The quantity of town gas that can be treated by sulfuric acid is limited probably by adsorption of unsaturates.

* * *

Results of Research and Investigational Work

Solubility of Paraffin Wax in Oil. Sullivan, McGill and French. (*Ind. and Eng. Chem., Vol.* 19, *No.* 9, *pp.* 1042-45). Paraffin waxes of 111 degrees F., 125 degrees F. and 145 degrees F. Saybolt melting points and containing relatively few individual hydrocarbons were obtained by the repeated fractionation of 125 degrees F. Saybolt melting point commercial paraffin wax from Mid-Continent crude. The solubilities of these fractionated waxes and of the 125 degrees F. melting point commercial wax itself were determined in petroleum ether (boiling point 21.0 degrees to 82.0 degrees C.) and in a number of Mid-Continent petroleum oils of varying viscisities. Some of the oils represent narrow cuts from a fractional vacuum distillation; others are blends of oils of widely-separated viscosities. Solubilities were determined at various concentrations and curves were constructed showing the variation of these solubilities with temperature, viscosity and melting point.

* * *

Thermal Decomposition of Organic Sulfur Compounds. Faragher, Morrell and Comay. (*Ind. and Eng. Chem., Vol.* 20, *No.* 5, *pp.* 527-532). Authors state that the object of the investigation was to study the thermal decomposition of organic sulfur compounds and to relate the results to the changes that take place during the refining and cracking of oil. The

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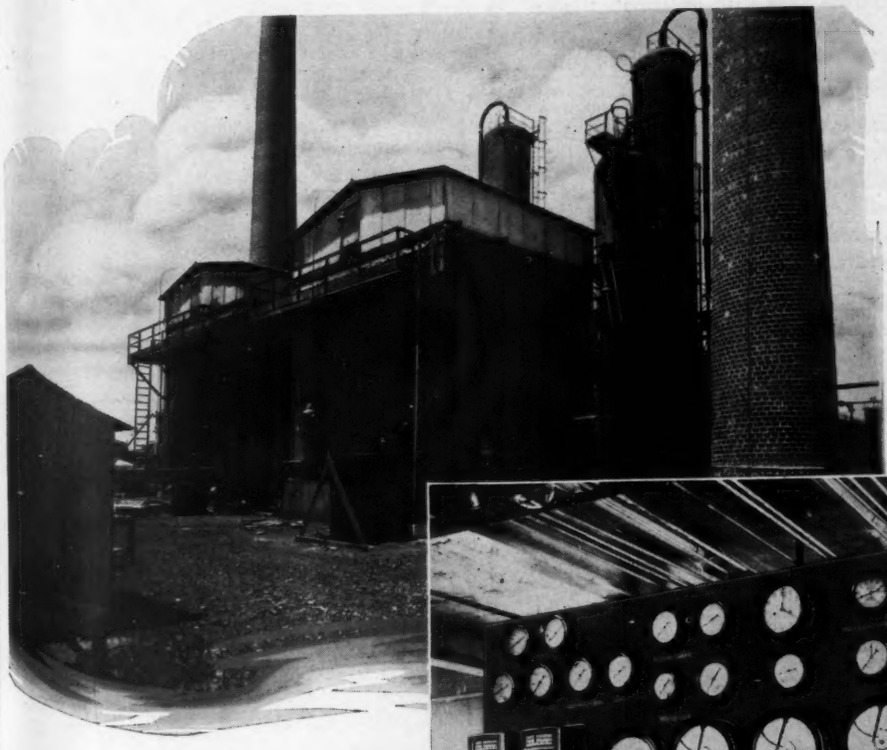

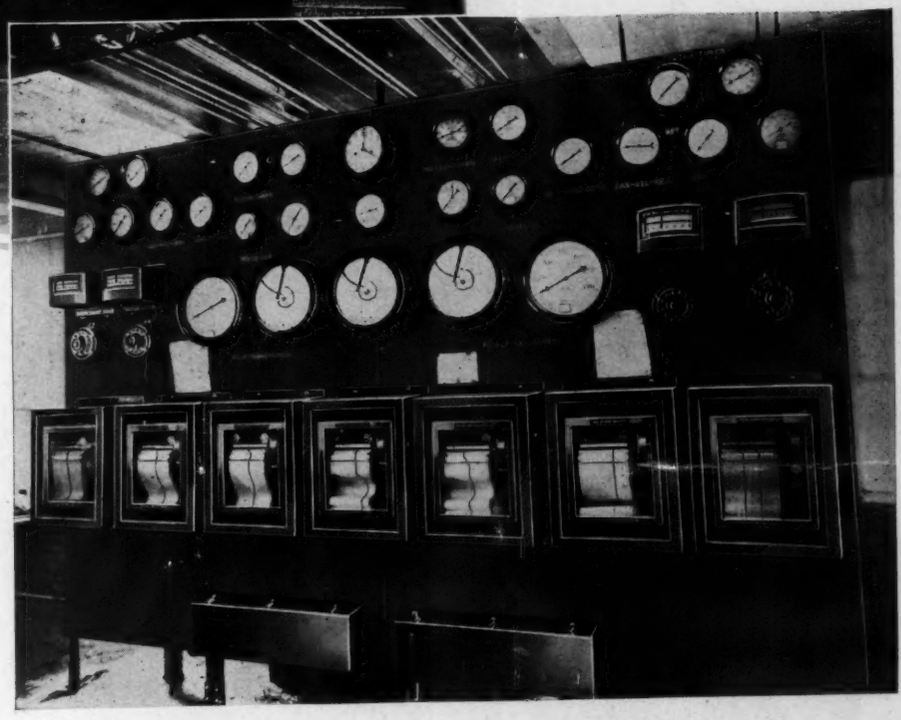

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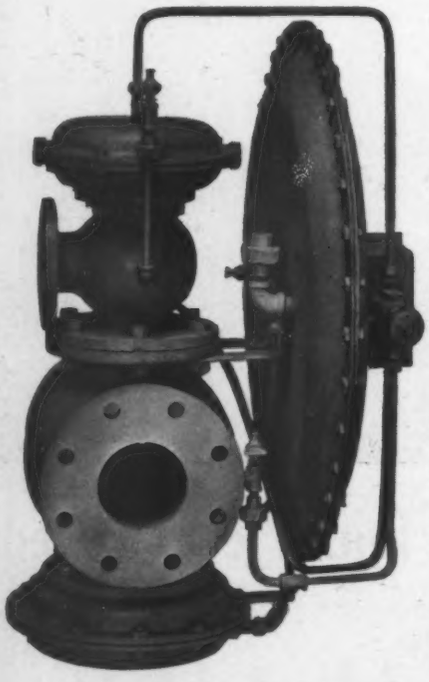

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following organic sulfur compounds were selected as representative of types considered to be present in petroleum: mercaptans, alkyl sulfides, alkyl disulfides, thiophene and elementary sulfur. All these substances were dissolved in naphtha made from Pennsylvania crude oil. The vaporized solutions were subjected to an average temperature of 496°C. The products of the thermal decomposition were identified. Comparative tests were then made with products of cracking in the liquid vapor phase under pressure.

* * *

Relation between Viscosity and Gravity of Petroleum Products. Hill and Coats. (Abstract of paper read at the Detroit meeting of the A. C. S., Sept. 5-12, 1927. *Libr. Bull., U. O. P. Co., Vol.* 2, *No.* 35, *p.* 300). From data previously published on the physical properties of the viscous fractions from various types of crude petroleum, a mathematic relation has been worked out between Saybolt viscosity and specific gravity. The relation is a logarithmic one and expresses the specific gravity in terms of the viscosity and a constant which is different for each crude and is characteristic of it. This "viscosity-gravity constant" is low for the paraffinic crudes and high for the naphthenic crudes. Its value for any oil is a direct index of the degree of the paraffinic or naphthenic character which it possesses.

* * *

Dopes and Detonation. Callendar. (Reports and Memoranda of Aeronautical Research Committee, No. 1062. *Dec.* 1926. The primary object of the investigation was to complete rational explanation of cause of detonation in engines using liquid fuel with especial reference to chemical side of problem; study of low-temperature oxidation of liquid fuels in air, in conjunction with engine experiments to determine relationship between detonation and observed chemical action; it is found that detonation is due to formation of organic peroxides, which become concentrated in nuclear drops during compression and ignite them simultaneously when detonation temperature of the peroxide is reached. It is suggested that isolation of organic peroxides and study of their properties might lead to discovery of more useful dopes than are known at present.

* * *

A New Crude-Oil Engine. (Petroleum Times. Dec. 3, 1927, *p.* 1074). Grayson in Australia has invented a constant-pressure combustion-cycle (Diesel-cycle) engine, which it is claimed overcomes the objections of high cost of building, excessive weight and low speed of rotation that have marked engines of this kind brought forward heretofore. Air is compressed sufficiently to produce a temperature of 900°F. Fuel is injected into the hot air and burns immediately.

* * *

Safe, Economical Storage for Fuel Oils. DePew. (Welding Engr., Vol. 12, *No.* 8, *Aug.* 1927, *pp.* 37-40). Welded, rectangular tanks of over 100,000 gallons capacity solve the storage problem at low construction cost.

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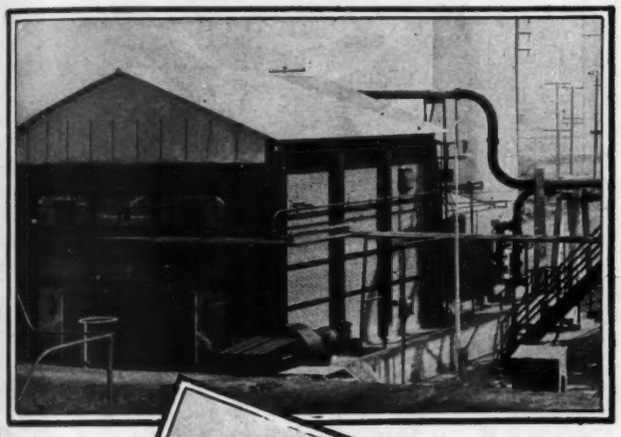
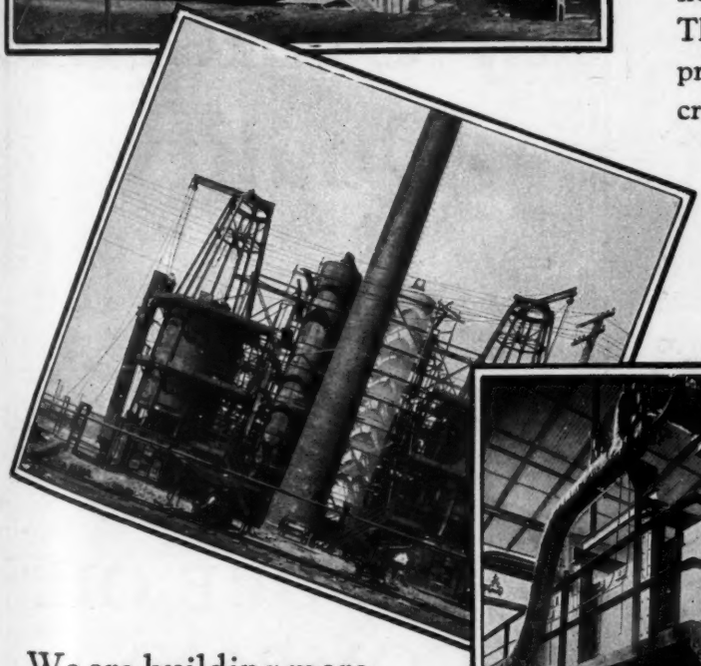
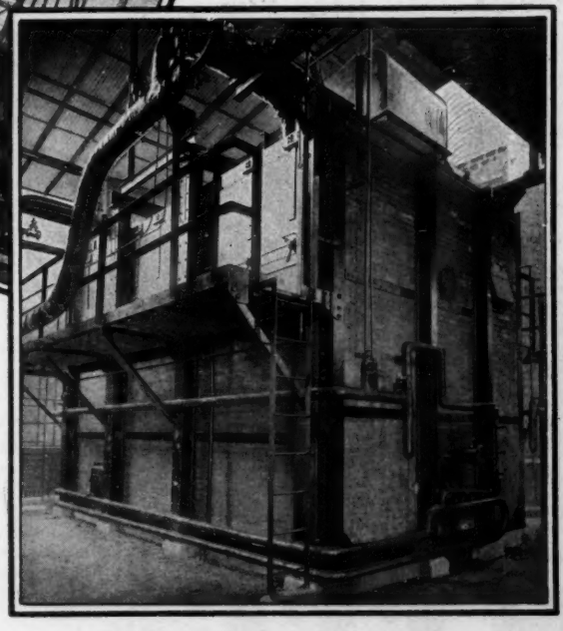
While we build each still to meet the specific requirements of a particular problem, taking into account the type of crude handled, the thru-put, percentage overhead, time of heating, economical efficiency, etc., the general principles of the design are the same in all.



Under agreement with the Texas Company, we, with one other concern only, are licensed to build and sell the deFlorez Vertical Heater for non-cracking installations. This heater was developed primarily for high pressure cracking work, but is now being applied to topping and relatively low-temperature operations.





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Tide Water Oil Co.
Anglo-Persian Oil Co., Ltd.
Empire Refineries, Inc.
Marland Oil Co.
Vacuum Oil Co.
Associated Oil Co.
Barnsdall Corp.
Humble Oil & Refining Co.
Tidal Refining Co.
Standard Oil Co. of N. J.
General Petroleum Corp.
Beacon Oil Company
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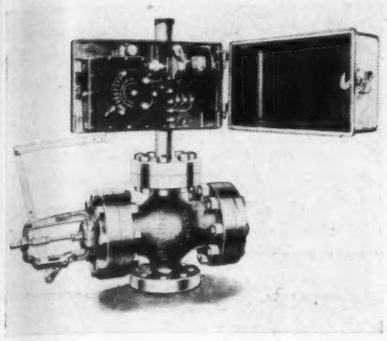
NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS



Automatic Flow Controller

Automatic Flow Controller

BROWN INSTRUMENT COMPANY

Brown Instrument Company, of Philadelphia, is making an automatic flow control valve to meet the requirements of accurate measurement of flow at high temperatures and high pressures, a problem of high pressures now commanding much attention in the field of steam plant design and in other applications, such as refineries and chemical plants.

In this new installation the Brown forged steel manometer is used with the Brown electric flow meter, operating on the inductance bridge principle, to govern specially constructed remote control valves. The accompanying illustration shows the latest product of Brown Instrument Company.

This valve is designed to control automatically the feeding of hot oil to an oil cracking still, and is built to operate at 1300 pounds pressure and 600 degrees Fahrenheit. The valve in the still feeder line is controlled by the setting of a Brown automatic control flow recorder located on the instrument panel of the control house, which may be any distance from the still.

The installation is typical of many applications to the control of steam, water or gases.

Lubricated Plug Valve

BARCO MANUFACTURING COMPANY

Barco Manufacturing Company, 1801-15 Winnemac Avenue, Chicago, has recently added the Barco LCI series 150 lubricated plug valve to its line of lubricated plug valves. Its use covers air, water, oil or gasoline, as well as steam, at low pressure, and is placed on the market at a lower price than the average line of Barco valves.

The plug is held securely in its seat in the body by mechanical means, the one gland having a double purpose of preventing leaks around the stem of the valve and holding the plug against the body at the desired pressure. The large gland is used so that the valve may be repacked without danger of the plug blowing out and causing injury.

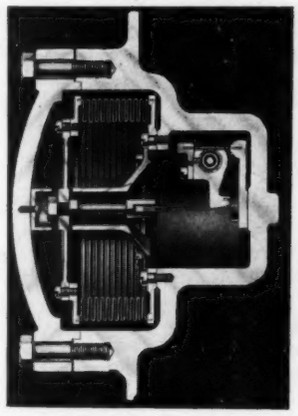
This valve gives a full area straightway passage with a quarter turn of the handle. A lubricant is used in this valve only to effect ease of operation and to prevent deterioration from water, corrosion and rust. This lubricant is not used for any other purpose and the construction of the valve is such as to keep it tight without the use of the lubricant.

Further information may be obtained from leaflet 312, which has been published to describe the new plug valve.

Pressure Recorder

NATURAL GAS EQUIPMENT, INC.

Natural Gas Equipment, Inc., Los Angeles and Tulsa, announces that it is manufacturer's representative for the new Anubis Differential Pressure Recorder. In this instrument no mercury or other liquid



Anubis Differential Pressure Recorder

column is used. Essential parts of the Anubis recorder comprise an elastic metal bellows within a closed chamber, a resilient "torsion tube" of spring tempered seamless steel, and suitable connections between these elements and to recording mechanism outside the chamber. Pressure from the upstream side of an orifice is admitted to the inside of the metal bellows, and from the down stream side to the chamber enclosing it. The result is a force acting against the free end of the bellows equal to the pressure differential.

The instrument comes from the laboratories of George Sidney Binckley, C. E. after 15 years of research and development, where the qualities sought in metering were a high degree of responsiveness and accuracy, especially at low differential values, simplicity of design and construction, and durability.

The elastic torsion tube performs the dual function of opposing to the movement of the bellows head a resistance which is directly proportional to the forces applied; and of transmitting that motion to the recording mechanism outside of the pressure chamber entirely by its elastic change of form, and without friction, wear, or leakage.

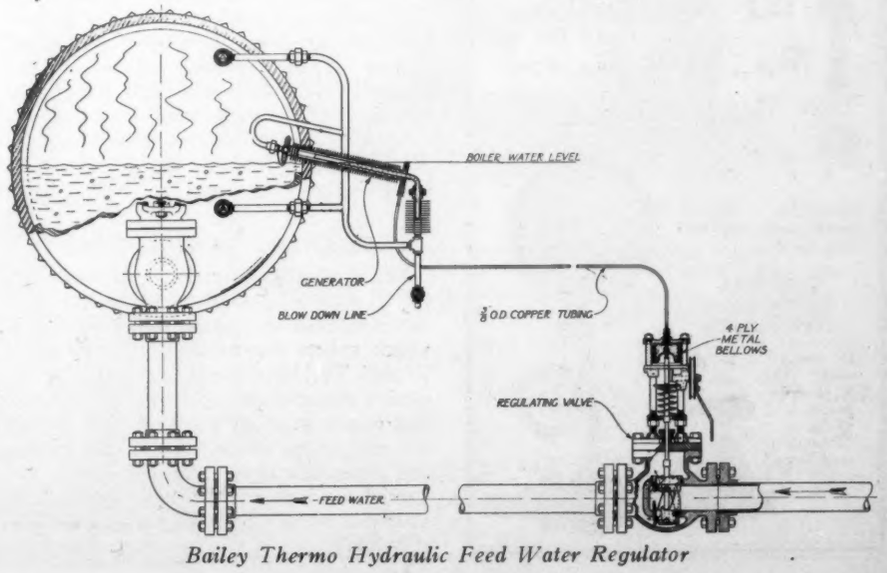
Full details of construction of the meter, the principles of its design and operation can be secured from either office of Natural Gas Equipment, Inc.

Thermo Hydraulic Feed Water Regulator

BAILEY METER COMPANY

A Thermo hydraulic feed water regulator embodying new and improved features was recently announced by the Bailey Meter Company of Cleveland, Ohio.

The design of the regulating valve used in this instrument permits tight seating, is fully balanced, and has scientifically designed V-ports, which features contribute to freedom from the danger of flooding boilers at low rates of steaming or when on bank, and smooth continuous feeding while in normal operation with a positive, non-chattering action of the valve. The design permits removal of the valve cage without removing the valve body from



Bailey Thermo Hydraulic Feed Water Regulator

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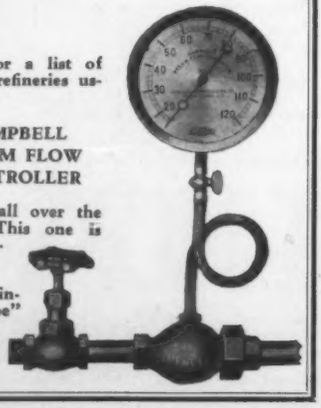
Write for a list of leading refineries using the

CAMPBELL STEAM FLOW CONTROLLER

In use all over the world. This one is a photograph of the "Pumpkin-seed Type"



the line in the event that seats must be reground. Recessed rings in the valve cage just below the seat prevent cutting of seats and valve discs. By means of such rings the flow is evenly distributed to assure equal wear on all parts of the seat when the valve is operating near the closed position.

A lever and cam are provided on the regulating valve to permit hand regulation, if necessary, through quickly opening the regulating valve by a half turn of the by-pass lever.

New features incorporated in the Bailey Thermo Hydraulic Generator, which is located at the boiler water level, are a cold water storage leg, a condensate by-pass and a vacuum seal.

The regulators are furnished in all pressure standards up to 1350 pounds. The regulating valve may be installed wherever convenient on the feed line, since only a hydraulic connection is required between the syphon on the valve and the annular space between the tubes of the generator. Details of the hook-up are shown in the accompanying diagram. This system, because of its all-metal ground joints, is practically leak-proof and seldom, if ever, must be refilled.

JOHN C. DIEHL MADE CHIEF ENGINEER OF AMERICAN METER COMPANY

John C. Diehl has been appointed chief engineer of the American Meter Company. Since 1919, Diehl has been engineer with the Metric Metal Works Division at Erie, Pennsylvania. In that capacity he has been in charge of the experimental laboratory, specializing in large volume, high pressure measurement. This laboratory has provided important results and its usefulness has been greatly extended under Diehl' direction.

As chief engineer of American Meter Company, Diehl will coordinate all experimental activities now being carried on in the several factories. He will also supervise the introduction of technical improvements in products, and promote in general any findings of value to the practical application of measurement engineering.

Diehl has been a frequent contributor to technical and trade press of the natural gas and petroleum industries and is the author of the revised edition of the Natural Gas Handbook, 1927. He graduated in 1905 from Pennsylvania College, Scientific Course, and in 1910 from the Massachusetts Institute of Technology, Civil Engineering.

TURBINE GENERATORS

Westinghouse Electric & Manufacturing Company, East Pittsburgh, has published and mailed out pamphlet No. 20378, which covers the subject, "Westinghouse Geared Turbine-Generator Units." It includes material on the general features and construction of the new 25 to 50 kw. d-c. geared turbine-generator sets. Photos and drawings show assembly, parts and special devices of the new units. The available ratings with dimensions are also scheduled.

Acid Proof Cement

U. S. STONEWARE COMPANY

The U. S. Stoneware Company, 50 Church Street, New York, has recently placed on the market its new acid-proof cement, selling under the trade name of U. S. Standard. This product represents research and experimental work of the past four years.

The cement is acid, alkali and corrosion proof against acids, alkalies, chemicals and gases, except for hydrofluoric acid.

This new product is for use on acid-proof tank linings, Gay-Lussac and Glover towers, acid-proof floors, acid concentrators, acid-proof fan casings, galvanizing and plating construction, acid-proof stacks and linings for acid gases and fumes. It is made especially for use in connection with U. S. Standard brick and tile.

Silica content of U. S. Standard acid-proof cement is given by the manufacturers as being 70.07 per cent, giving the cement high refractory properties.

This new cement is pulverized through a fine mesh, allowing it to set a dense and tight body. A battery of special machines has been installed designed to keep the percentage of impurities to minimum.

Production of the U. S. Standard cement has been centralized in Plant No. 3 of the U. S. Stoneware Company, Tallmadge, Ohio.

HEAT EXCHANGER CATALOG

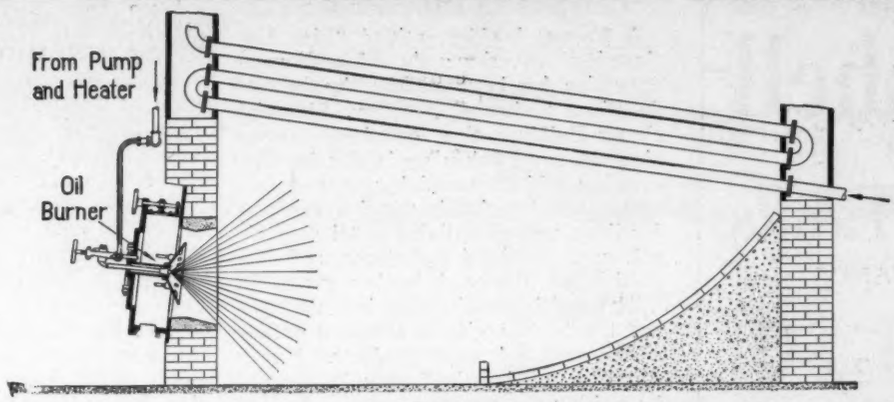
The importance of heat exchangers in petroleum refining has been outlined by Foster Wheeler Corporation in a recently published catalog, which deals with the subject in an unusual way. It first discusses the general requirements of heat exchanger design and construction, and then gives a detailed study of the most economic division of the work of heating the oil to be distilled. The problem of what percentage of the work should be done by heat exchangers and what percentage in tube stills to give the most economic performance is worked out from actual practice, figures being given in detail.

A complete description of liquid exchangers, vapor heat exchangers and partial and final condensers is given in the last section of the catalogue. Baffling is discussed and described with drawings; operation is described, and the whole gives a very complete idea of the heat exchanger phase of refining.

The booklet is profusely illustrated, and copies may be secured upon request for bulletin OH-29 addressed to the Foster Wheeler Corporation, 165 Broadway.

TURBINE BOOKLET

The Terry Steam Turbine Company, Hartford, Connecticut, describes in pictures and story its various turbine units and equipment in a neat booklet just off the press. Two four-page loose-leaf folders, S-76 and Z-1, brings up to date the loose-leaf bulletins covering this company's equipment.



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Mechanical types using natural or forced draft — Also steam actuated types.

Complete system includes burners, air registers, heaters, pumps, strainers, etc.

Bulletins 16-OA and 16-OG give complete information.

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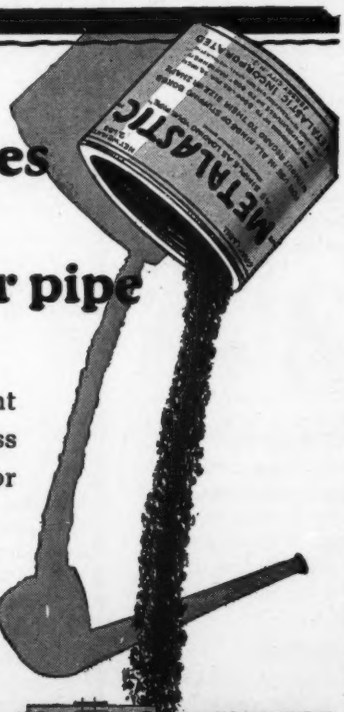
The S&K line includes heat exchangers, condensers, valves, spray nozzles, gear pumps, etc., for the oil industry.

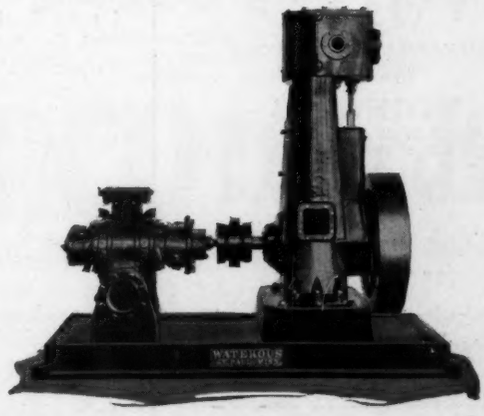
Packing Stuffing Boxes as easy as loading your pipe



Serves in any plant equipment, regardless of service, pressure or temperature.

METALASTIC INCORPORATED
Jersey City, N. J.

WATEROUS ROTARY PUMPS



The above pump is handling fuel oil for one of our largest railroads. It is direct connected to a well known make of steam engine. Forty years of building rotary pumps is behind this product. Rugged construction, accessibility, and high efficiency are built into the Waterous Rotary. Your inquiries are solicited.

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THE ONLY PAINT TRIED, TESTED and USED EXTENSIVELY by the PRINCIPAL COMPANIES

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STOP THAT CORROSION TO-DAY!

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HOLZAPFEL'S HEATPROOF PROTECTIVE

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RED HEAT!

Use it on any surface too hot for other paints

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PIPE ENGINEERING

A 96-page booklet entitled "Pipe Engineering," covering redwood continuous stave pipe, has been published by the Little River Redwood Company, Financial Center Building, San Francisco. Forty-nine topics are taken up in this booklet, covering subjects pertaining to manufacture of wooden pipe, installation, supports for lines, pressures, lining metal pipe, air valves, connections, curvatures, and discussion of Redwood lumber generally. Tables and illustrative drawings throughout the booklet give a complete outline of the company's many products. A copy of "Pipe Engineering" may be secured by writing the company.

"Water Cooling Systems" and "Cooling Towers" are two subjects covered by the Little River Redwood Company in two four-page illustrated folders recently published.

OIL RECLAIMING PROCESS

Westinghouse Electric and Manufacturing Company has announced the release of leaflet No. 20287-A, which explains the use of the Sharples oil reclaiming process equipment in application to circuit breaker oils. The leaflet describes the apparatus used in this process, and, with the aid of photos and diagrams, shows the operation and construction of the unit.

DIESEL BULLETINS

Busch-Sulzer Brothers Diesel Engine Company, St. Louis, has recently mailed out three bulletins, which will be gladly sent to individuals interested upon request to the company.

"Why Shouldn't Estherville Be a Diesel Booster?" is a history of a Diesel plant, written by G. R. Connelly, superintendent of public works at Estherville, Iowa. Eugene B. Miller, superintendent of the Electric Light and Power plant, Opelousas, Louisiana, is author of the second bulletin, "Busch-Sulzer Diesels Changed Losses to Profits at Opelousas." The third bulletin, "History of a Diesel Engine Plant," is written by J. Bryan Miller, city manager, Bryan, Texas.

VALVE BULLETIN

Schutte & Koerting Company, Philadelphia, has just published a new edition of its bulletin 8-B, describing the S. & K. line of stop, check, nonreturn and triple duty valves for steam pressures up to 1500 pounds. This bulletin has been sent out to replace the 1927 catalog. This completely illustrated bulletin, 40 pages in length, will be mailed upon request to the main office and works, Philadelphia.

NEW PACKING

Greene, Tweed & Company, 109 Duane Street, New York City, has recently developed three new packings, "cutno," "pelro," and "palco," following a period of research for the proper compounds to resist the destroying and washing out tendencies of the various fluids pumped. Free working samples will be sent for a practical test if size of packing and service under which it is to operate is mentioned, according to an announcement from the company.

Amco Sales Corporation, 233 South Eighth Street, Philadelphia, distributors for the A. Y. McDonald Manufacturing Company, has recently put in a complete stock of McDonald oil handling equipment for the purpose of giving better service to buyers of McDonald equipment in the Eastern States.

Overnight shipments or immediate pick-ups can be made in the Philadelphia trade area from this new stock. C. R. Gates is manager of the Philadelphia branch.

J. L. Farrell, formerly assistant superintendent of the Parco, Wyoming, refinery of Producers & Refiners Corporation, has resigned his position to become associated with Arthur G. McKee & Company of Cleveland, Ohio.

Pioneers

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FORGED STEEL FLANGES

MADE IN HOUSTON

Boiler Flanges
Tank Flanges
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Boiler Tubes

HARRISBURG PIPE & PIPE BENDING CO.
OF TEXAS
Sawyer and Winter Sts.
HOUSTON, TEXAS

SULPHURIC ACID PROCESS

A new booklet published by the Selden Company, manufacturer of chemicals, Pittsburgh, describes the company's new contact sulphuric acid process. The story of this new process is briefly, yet fully told in five pages, following which two charts are carried showing temperature curves. Illustrations are given on the Chemico sulphur furnace, sulphur pumps, Chemico boiler and cooling furnace, Chemico coolers, the company's 40-ton converters assembled and a 120-ton plant in construction.

SUPERHEATER

The Superheater Company, 17 East 42 Street, New York, N. Y., has issued Bulletin T-19, "The Elesco Multiple-loop, Single-pass Superheater," which has been published to illustrate how the same basic principle, the multiple-loop, single-pass arrangement, applies to all Elesco superheaters for stationary boilers. A study of the contents will show, except for slight variations, the same advantages are had in each type of Elesco superheater application. A copy of the bulletin will be supplied upon request to the company.

FIRE FOAM

American Fomon Company, Drexel Building, Philadelphia, has published an 18-page pamphlet, titled The Answer to the Foam Question. Description of the foam product, its production and uses is given, with photographic illustrations showing the successful extinguishing of fire.

GAS BOOSTER

Bulletin No. 233 published by the Connersville Blower Company, Connersville, Indiana, supersedes a previous edition, in describing the company's Victor gas boosters, used for gas burning furnaces and also for booster service on distribution lines and in processes where clean gas is handled. The bulletin includes tables which designate the capacities of the different sizes and types of boosters. The machines arranged for either belt drive or direct motor drive are illustrated. A copy of this bulletin may be obtained by witing the above address.

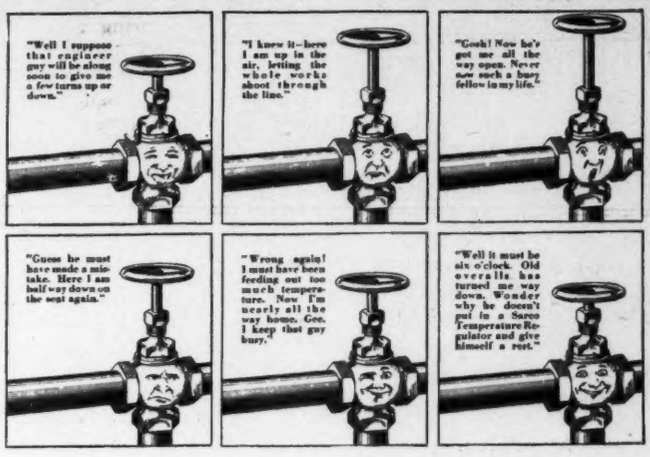
ROLLED ZINC

The New Jersey Zinc Company, 160 Front Street, New York, has mailed out a 44-page booklet titled Rolled Zinc, which in description, illustrations and tables gives the reader a logical insight into this product. A copy will be supplied upon request.

ALLOY PRODUCTS

General Alloys Company, 405 West First Street, Boston, has just published a number of bulletins describing its Q-Alloy products. Bulletin 38 takes up heat-treating containers, Bulletin 41 covers furnace parts, while more than a half dozen folders have been issued describing the work of the company's products in various lines of manufacture. A full line of this literature will be supplied upon request at the Boston address of the company.

Ever Wonder What a Valve Thinks About?


"Well I suppose that engineer guy will be along soon to give me a few turns up or down."
"I know it—here I am up in the air, letting the whole works shoot through the line."
"Gosh! Now he's got me all the way open. Never saw such a busy fellow in my life."
"Guess he must have made a mistake. Here I am half-way down on the seat again."
"Wrong again! I must have been feeding out too much temperature. Now I'm nearly all the way home. Gee, I keep that guy busy."
"Well it must be six o'clock. Old overalls has turned me way down. Wonder why he doesn't put in a Sarco Temperature Regulator and give himself a rest."

If the valves on your line could only talk, we wouldn't have to do any advertising! The very fact that it is necessary for you to make frequent valve adjustments ought to prove to you that you cannot accurately maintain temperatures by this old-fashioned method.

Why not follow the lead of thousands of others and try the Sarco Temperature Regulator? This well-known device is entirely automatic. You simply install it and then forget all about temperature regulation. Sarco will do the regulating for you. Always accurate. Always on the job. It can't forget. It can't get out of order. And it can't make mistakes.

The Sarco costs little to buy and install. Operating costs are practically nothing as it needs no compressed air, water pressure or electricity. And it costs practically nothing to maintain.

Let us prove the value of SARCO Temperature Regulators in your plant. Write us to send one on a 30-day free trial. If it doesn't give perfect temperature control and save your time, return it to us and the trial won't cost you one cent.

Booklet No. S-60 gladly sent upon request.

SARCO CO., Inc.

183 Madison Ave., New York, N. Y.

Boston, Buffalo, Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh, St. Louis, Peacock Bros., Ltd., Montreal

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Write us for samples of colors you wish to try

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